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THEO. S. CASE, M. D.

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KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VIII. MARCH, 1885. NO. 11.

MEDICINE AND HYGIENE.

SANITARY PLUMBING.[1]

JOHN FEE, M. D.

I feel highly honored and gratified with your invitation to address you this evening. It gives me pleasure to meet this Society, composed of gentlemen engaged in the same work, that of practical sanitation, which has occupied my time and labor during the past four years.

I feel gratified with the privilege of meeting you here because I know we can enlighten the people of this city in regard to proper plumbing and house drainage, and place one branch of the art of practical sanitation in such prominence before the public that its untold benefits may be properly understood and appreciated.

We have reached the time in this city when the public must be instructed in regard to one of the most indispensable arts known to man; an art which, more than any other, perhaps, makes the possibility of a great city, and without which mankind would spread out over the country and harmonize with the teachings of Mr. Ruskin.

The intelligent plumber is a practical sanitarian, and his work properly done gives cleanliness, comfort and health. The work of the ignorant and unscrupulous plumber, however, brings expense, discomfort and disease.

1 Delivered before the Master Plumbers' Association of Kansas City, February 10, 1885.

This city is in a transitional stage; it is passing from the town into a city, which if judiciously governed and instructed will, in a short time, become a great metropolis.

To the people of this city then, the study of sanitary regulations has become a necessity. It has been my fortune to investigate, to some extent, the chief great lines of human thought, theology, jurisprudence and science; and during the past four years my study has been exclusively devoted to sanitation, or to the protection of the public health, and I have no hesitation in saying that this latter science is the most essential field for human study and investigation, and offers to society the most practical results and the greatest benefits.

To the student of history there is a great fascination in the study of the moral, social and intellectual development of our ancestors; and no man living amidst railways, telegraphs, and comfortably constructed dwellings can go back to the days of the earliest history of our Indo-Germanic ancestors, when they were but little more than savages, and then trace their development; first, their wrestle with religion; next, their struggle for personal and political liberty, and subsequently their invention of the practical arts and sciences without mingled feelings of pride, wonder and reverence.

In surveying the results of the intellectual development of our race, we must be struck with two facts, namely: The centralization of mankind in great cities, and their increased attachment to this earthly existence. The massing of human beings in great centers seems to be the unavoidable result of our material and social development. These cities are manufactories of all those articles which we consider necessary to our comfort. These are also the centers of thought and of intellectual production and mental commerce, which, in the present brain development of our race are as essential to our happiness as are our material inventions.

The increased attachment of mankind to this earthly home as a result of our modern civilization, is equally apparent. In making this statement, I would not underrate popular faith in a future existence. No doubt this quality of mind is as general now as it has been at any time past in the history of the race, but such are the comforts, material and intellectual, which environ our present existence, that the majority of mankind prefer to bear the pleasures and enjoyments which they have, than to flee to those they know not of. There is nothing strange in this worldly attachment; it would be unaccountable were it otherwise. When we consider the advantages which surround our existence, compared to the meagre pleasures and conveniences of our ancestors, our homes seem like dream-lands, and our material and intellectual advantages like hallucinations or flights of imagination. Let us for a moment survey some of our advantages.

First, we may remark that the invention and use of the sewing machine, electric light, telephone and telegraph are within our own recollection. To some of us this is true in regard to the invention of and use of the railroad, steamboat, and steamship. The use and application of light within our recollection has almost revolutionized our social organization. For all purposes of business or

pleasure, we have made the night almost as subservient as the day. On the contrary, how gloomy must have been the long winter nights of our ancestors without illuminated streets, and with houses dimly lighted with rude lamps?

Gas for illuminating streets was first used in London in 1816. The candle is a comparatively modern invention. The so-called candles alluded to by the ancients and in the Scriptures, are believed to have been rude lamps for the burning of olive oil, and these were continued down to the end of the eighteenth century. The first improvement in wicks took place in France in 1783.

The use of spectacles did not become general until after 1313, when they were invented by an Italian monk. This universal boon to mankind ought to be considered a very considerable set off against relic worship and asceticism.

Think of one reaching forty-five years of age and then the print of the newspaper growing dim, week by week, until at fifty one is shut off from the news forever. Again, the first weekly newspaper was not printed until 1615, when it was issued in Frankfort-on-the-Main; but the real newspaper, the morning daily, with its fresh news from all parts of the world, is a work that has been perfected and brought into successful operation within the period of our own memories.

But again, nowhere do the advantages of our modern civilization and the disadvantages of our ancestors stand out so conspicuously as in the comparison of habitations. Chimneys were unknown before the fourteenth century, and did not come into general use for a long time afterward. It is even said that the ancients had no knowledge of chimneys. We have only to contemplate our comfortable rooms, heated with stoves or hot air furnaces, or with steam, and then to view our ancestors hovering over a few coals in a dim, smoky room, with no place for the escape of smoke and the poisonous products of combustion, except a hole in the roof, to appreciate our inestimable advantages. Window-glass, also, did not come into use before the fifteenth century. Paving the streets was unknown to our ancestors until 1184, when it was first tried in Paris. It seems to have been an invention which made but little impression on the people, as it was not introduced into London until 1533. Sewers were unknown to our progenitors until the beginning of the thirteenth century and were then only used for the removal of storm-water. Until a comparatively recent period, the discharge of sewage proper into the sewers was prohibited by law in London. The use of sewers for the removal of house waste is an invention of the present century.

But I will not dwell longer on the enumeration of those inventions which are calculated to give a charm and to impart an attachment to this existence unknown to our forefathers.

Although we have elaborated the fact that the tendency of our modern civilization is to the congregating of mankind in great cities, and have pointed out the many gains which we possess over our ancestors, we have yet to mention the additional fact that all these benefits have been obtained by many sacrifices, and that there are innumerable dangers inseparable from our present social organization. These dangers are such as affect the public health. The very flocking

together of human beings into great cities brings numerous diseases, both to infantile and adult life. In fact, these maladies, such as diphtheria, measles, scarlet-fever and small-pox, have threatened at times to destroy great municipalities.

The overheating in the summer season and the ill-ventilation of residences decimate cities of their infantile population. Commerce, too, is a constant menace to mankind, because it brings not only an interchange of products, but also an exchange of diseases.

The ships which come from the Ganges and the Nile to the occident, laden with their rich cargoes, bring with them pestilential cholera; and vessels which sail from tropical ports laden with coffee, sugars, and fruits, bring with them the seeds of tropical fevers; and thus there is a bitter for every sweet, and an enemy skulking in ambush for every friend. It is the mission of sanitary science to give success and permanancy to our modern civilization in every land and in every clime; in a word, to protect the growth and insure the success of great cities. This has been effected for many great cities. The city of London, for example, contains a population equal to that of New York, Paris, and Berlin put together, and yet has a lower death rate than either one of these cities. Sanitary science constitutes a broad and inexhaustible field for human investigation.

It includes a large scope for jurisprudence for law making, international, national, state and municipal. In some countries, sanitary legislation has received a study equal to its importance, and in some parts of the United States, particularly in the State of Massachusetts, it has become an elaborate and useful code, both State and municipal. Practical sanitary science includes the profession of the architect as to heating and ventilation, the sanitary engineer or sewer builder, the plumber, and the chemist, who devotes himself to the study of foods and the prevention of the crime of food adulteration. Here let me digress for a moment and point out the fact that the adulteration of foods is the greatest and besetting crime of the age, and of this country and of this State in particular—that substance only, which is not adulterated, is that article which is cheaper than any adulterant.

Coffee, tea, sugar, molasses, candies, honey, butter, lard, oil, liquors of every description, drugs of every kind, all are adulterated, and no legislature, no State board of health brings the miscreants to justice. Again, sanitary science includes the physician who studies the nature and history of pestilential diseases and their prevention. It includes the labor of the practical health officer, who enforces proper regulations for municipal cleanliness; for sanitary science, when reduced to first principles, to its quintessence, is cleanliness. The architect's endeavor to secure proper ventilation of the home is but an effort at cleanliness. The sewer is an adjunct for cleanliness, and the pipes for house drainage and water-service put in by the plumber are means for reaching the same end.

Sanitary science is the enemy, the antipode, of Malthusianism. It endeavors to prolong life, to save life, to fight off death. It teaches that society has an interest in the preservation of every human life, a social, a moneyed, a material interest in the protection and prolongation of every human existence. It assumes

that the child must live for the parent, that the investment of money, love and affection by the parent must be reimbursed and returned by the offspring. It has no fear of the over-production of the human race, and no alarm lest the food supply of mankind will leave them without subsistence. Although I believe that the teachings of Malthus are false and untenable in theory, yet it is a fact that they have been verified in many countries. In many of the capitals of Europe, and in some of the cities of this country, the annual death rate has equaled and in some years more than equaled the birth rate, so that were it not for the constant recruiting of population from the rural districts, the population of these cities would diminish or even become extinct. Some of these cities, however, with the highest and most abnormal death rate, have grown with unparalleled vigor and rapidity, owing exclusively to the influx of population from the country districts.

This destruction of human life in great municipalities, however, has no necessity. It has no compensating advantages to the race; it is not, to any great extent, in obedience to the law of food supply, but is purely the result of human ignorance and indifference to those conditions of health which surround us. It is the result of defective sewerage, ignorant plumbing, ill-ventilation, the overcrowding of tenement houses, and the non-observance of cleanliness, all of which evils characterize all great municipalities. With these general remarks, let us consider particularly the business or profession of the practical plumber.

The plumber is a practical sanitarian and is, perhaps, the oldest worker in the art of protecting the public health. His art reaches far back to the first pages of history. He was known to Jerusalem in the days of the magnificence of Solomon, to Babylon when she was the seat of empire, and to Athens and Rome as they successively triumphed as the controlling powers of the Orient. Wherever the genius of man founded great cities, the homes of wealth and splendor, and the centers of political influence and power, there the cunning of the plumber was invoked to bring pure water from the rivers and lead and control it within the habitations of man, and to give comfort and health to palaces and luxury to the king and his court. In modern times the plumber has figured more conspicuously. His art has been used not alone for bringing limpid streams into palaces for the gratification of courtiers and kings, but it has brought the luxury of pure, wholesome water into the habitations of the poor, into the workshop and manufactory, and has made it subservient to numberless uses unknown to the ancient world, such as for heating purposes and for driving machinery, and thereby relieving man of much drudgery. We are, therefore, principally interested in the plumber of the present day. On this point we may remark, that plumbing is a progressive art, and has undergone many improvements within a comparatively recent period. The practical inquiry then presents itself—what is the state of the art in this city? Has the work performed here been done in the best style of the art? Before answering this question I will say that I have every reason to believe that the gentlemen before me are as well versed in the theory and art of their profession as any equal number of plumbers in any other city of this coun-

try. In answer, however, to my inquiries I think the majority of you will agree with me in saying that the plumbing which has been done in this city has, in the greater part of it, been done in a very unsatisfactory manner. Of course some exceptionally good jobs of plumbing have been made, but as a rule the plumbing work is not up to the latest demands of the art. This is not only true of this city, but it is true of every city where there are no plumbing laws and no inspection of the plumber's work. The condition of plumbing in this city could not possibly be worse than it was a few years ago in Boston, New York, Brooklyn, Washington and Chicago, before their plumbing code came into existence. Let us inquire what are the causes of inferior and dangerous plumbing. First, property owners are largely responsible for cheap plumbing. Many of them have very crude ideas of plumbing and care less to learn anything about it, and know nothing about the dangers of drainage gas. They are eager to drive a smart contract with the plumber, just as they would bargain for the excavation of the foundation by the cubic yard, or for the brick by the thousand, so that they often get cheap plumbing, with typhoid fever and diphtheria thrown in for nothing. The avarice of property owners and their indifference to healthy plumbing is one of the almost insurmountable obstacles to correct plumbing. But again, the indifference and ignorance of some architects as to correct plumbing is another difficulty to be overcome. We have in this city as intelligent a body of architects as can be found elsewhere, but, gentlemen, I impart no secret to you when I tell you that there are architects in this city who cannot write out correct and proper specifications for a complete system of house drainage. Now, we all know that in order to put in a perfect system of house drainage it should be properly provided for by the architect, from foundation to roof, and that if the architect does not do his work properly the plumber cannot perform his.

In this work of correct plumbing the architect has the greatest responsibility, for however avaricious the builder may be, he generally puts great confidence in his architect, and imagines that what the architect does not know is not worth finding out. It is the solemn duty of every architect practicing his art in a great city to make an exhaustive study of plumbing and not to be satisfied with a superficial knowledge of this subject, gleaned from some occasional article found in an architect's journal, or from some specifications of a plumbing contract observed in some book of contract forms, or obtained from the pictures of plumbing fixtures found in some advertising manual which has come gratuitously into his hands from some wholesale manufacturer. It is not enough for the architect to know that the foundation of the house is all right, that the walls will not crack, that the roof will not fall in, that no ordinary wind storm will blow it down, or that no common tramp can raise the window or pick the front door lock ; it is his business to know that he has not written up and perfected plans and specifications for a nest of typhoid fever and diphtheria. But plumbers, gentlemen, have their responsibility in this matter. Have you, as a body, banded together and endeavored to enlighten the community as to the importance of correct

plumbing, and as to the dangers of cheap and imperfect drainage? And have you superintended all your work punctiliously? Have you scrutinized every joint, every gasket, every pipe, as to weight and freedom from imperfect casting? Were there no flaws in the drain pipe, was it properly glazed and laid at a proper inclination? These are questions for you to answer in your moments of self-interrogation. It is only a few weeks since, that a plumber was arrested and punished in New York for carrying through the roof of a house, a phantom or dummy soil pipe. I suspect, notwithstanding the heartless motives unjustly imputed to the plumber, that there are times in his history, when he takes up the morning paper and reads the death notice of some child, that has been removed by diphtheria, in which a feeling of chagrin and remorse steals over him. But again, the city government, the health department, and the sanitary superintendent are responsible for this lack of correct plumbing; for it is a fact, that good plumbing is not general in any city unless regulated and obtained by law.

As long as street cleaning or the removing of garbage is not regulated by law, so long will the city be filthy. So long as every man is let to adulterate food, so long will the common necessities of life be debased by heartless men, and so long as the building of a system of house drainage, in any building, public or private, is left to the avarice or ignorance of any man, so long will that art jeopardize the safety and welfare of the community. As before remarked, I suppose that some of the plumbing work in this city has been faultless, both in theory and construction, but it has not fallen to my lot to see any of this work. I have, however, been credibly informed of its construction. I have, on the contrary, seen numerous instances of incorrect plumbing. I have seen soil pipes without fresh air inlets, and terminating on the same floor as the fixtures, or on the first or second floor, without going up through the roof. I have seen a soil pipe in a residence end in the chimney. I have known it to terminate in the smoke-stack of a public building, either to be filled up with soot or, under some circumstances, to be so affected by the draft as to unseal the traps. As a rule, I believe that the danger of the siphonage of traps has been wholly overlooked and ignored in this city. I have never seen a common "S," or siphon trap, ventilated in this city, yet I know that there is not a city, where there is a plumbing law, that would allow an "S" trap without a vent pipe to be connected with any fixture of a soil pipe.

Now, gentlemen, I think you will agree with me when I say that we need a reformation in the plumbing work of this city. That reformation should begin first with the work of putting in the water service. There is nothing so essential to the public health and comfort as the general use of the water service. We need in this city to get our water supply from above Argentine, or preferably above Wyandotte, and then we shall abandon all cisterns and wells. In fact, no well should now be allowed by law within the city limits. Water then should be introduced from the public supply into every tenement and lodging house and into every habitation in the city. But the water service pipe must be put in differently from the work done heretofore. This freezing of the water pipe or shut

ting off water from the household during two months every winter must be stopped. It is the business of the plumber to put in the pipe so that it will not freeze, to jacket it with resin or plaster-of-Paris, or with some other non-conducting material, so that it will not freeze up. There is nothing that brings your art into such disrepute as the yearly freezing of the water service pipe, and the little money you make by repairs of frozen pipes is more than ten-fold counter-balanced by the fears and prejudices of house-holders against plumbing on account of this annual bursting of pipes and the expenses and damage incurred thereby. No plumber should ever put in any water pipes which he knows will freeze up, without a decided and vigorous protest. With regard to drainage pipes all should demand that the work and material be equal to the most advanced knowledge of this service. To affect this purpose the work will have to be inspected by a practical plumber acting under municipal authority, and municipal authority will have to be secured through the members of the city council. Here you may meet with difficulty, but perhaps not with as much as you may expect. I believe that Kansas City to-day is ahead and in the lead of all the cities of the State in sanitary matters and that the public sentiment here is more progressive than elsewhere within the State.

The greatest drawback in this city is want of money. We need money for a city hall, for a hospital, some people think for a market house, and for grading and sewering the city, so that our legislators are apt to think we have none to spare to pay more city officials. It seems to me, however, that the inspection of plumbing is too important a matter to be delayed on account of the demands on the treasury, and that the expenditures of the city, in other directions, should be so curtailed as to leave a fund for the inspection of plumbing. Within the last ten days numerous complaints have been made to me of sickness induced by drainage or soil-pipe gas. I have been so busy that I could not inspect the localities reported, but I fear that on inspection the complaints will be found to be true.

Again, if the inspection of plumbing is delayed for a number of years it will be a very difficult matter to remedy defects, and property owners will be indignant at the great amount of work to be torn out of their buildings. In a matter of such vital interest to the public health, the expense of a plumbing inspector ought not to form any valid objection, and I believe will not when the facts are properly presented to the city council in regard to the legislation which you require. I hope, gentlemen, that before another year your influence will be felt throughout the country. Other associations within the same time have achieved a national influence and reputation. The master plumbers of Chicago, for example, illustrate the truth of my statement, as shown by the following extract from a lecture recently delivered at Hershy Hall by Dr. O. C. DeWolf, health commissioner of that city. The doctor says:

"One year since you did me the honor to invite me to address you on such a subject as would mutually interest us as sanitarians, and, on that occasion, I met, for the first time, a body of artisans of whom I had known much and seen

little. I ventured to suggest to you the importance of intelligent organization, and pointed out to you some of the results to your guild which might be expected to follow such united and harmonious action. I am surprised at the work you have accomplished. I have seen the president, recording secretary, financial secretary and a majority of the executive committee of the National Association taken from your ranks, and to-night you stand among your fellow craftsmen the most influential body of plumbers in the United States. This statement will not be denied by any one who has followed the professional literature of your guild for the past few months. I congratulate you and rejoice with you. As a preface to what I have to say to you to-night, I wish again to emphasize the importance to yourselves of a wise, broad, intelligent, active and generous spirit of association, both for personal benefit and that the influence of your organization may be as far-reaching and potential as you desire."

Here, gentlemen, I should, perhaps, stop, but I cannot refrain from making some suggestions to you in regard to your avocation and its relation to your pecuniary, social, intellectual and political influence. Your vocation is a peculiar one. It is not a business which simply requires labor, even skilled labor, but it is both an art and a science. The man who can wipe a joint perfectly, who knows the mechanism of a flush-tank, or of a system of house drainage or of steam fittings, is not, therefore, a perfect plumber. He must not stop with the mechanism of the business, but he ought to know much of its theory and of the chemistry and science of the materials with which he labors. The plumber ought then to be more than a laborer; he should be a skilled and scientific artisan. I take it for granted that the object of your association is personal improvement, intellectual, social and pecuniary. What then will contribute to your success? I answer, to raise the standard of intelligence, of professional skill and social worth high in your association. Make the admission into your guild as difficult and not as easy as possible. Lengthen out the period of apprenticeship. I do not know how long it is, but it should in my opinion be not less than five years. In addition to this, you should require of your apprentices a regular course of study and annual examinations, which could be made before a board of examiners appointed from your association. To my mind, a programme of examinations like the following might be adopted: At the end of the first year, examination in arithmetic and book-keeping; second year, algebra and elements of drawing; third year, algebra continued and mechanical drawing; fourth year, elementary chemistry and hydraulics; fifth year, hydraulics continued and the special chemistry of water and of the metals. These studies could be pursued during the long winter evenings and would take the young apprentice away from the evil allurements of city life and would force him to spend his otherwise leisure hours in a school for mathematical instruction and in the laboratory of the practical chemist, and would cause him to become a thoughtful, well-rounded man, and an influential citizen.

Nothing lowers and debases a business or avocation so quickly and surely as easy and cheap access to it. All the evils of low wages, scamped or inferior

workmanship, of unfair and dishonorable competition, of jealousies and of professional envy and backbiting, can be traced directly to short and hurried apprenticeship. A business or profession which shortens its course of study of apprenticeships, which eagerly seeks every youth for its pupil, and opens wide its portals of instruction, offering every inducement which appeals to indigence, ignorance and to mental inactivity and stupidity, is not worth having, and is alike disgraceful and dishonorable to the recipient and to the donor. Again, gentlemen, I say, make your standard high, access to your ranks difficult, the period of apprenticeship and of instruction long and exacting, and do not fall in with the popular idea of license instead of liberty, which accords to any man the right to follow any profession or carry on any business, however intimately or delicately associated with the public welfare, without a previous training and instruction for intelligently and skillfully discharging its obligations. Permit me to say, in conclusion, that for reasons which are now manifest, I ought not, perhaps, have acceded to your invitation to address you. My official duties during the past four years have been so numerous and exacting that I have had no time for literary composition and for preparing a lecture, such as would do justice to you or myself. But I could not resist the opportunity of co-operating with you in your first efforts in this city. And, gentlemen, whatever shall be my future in this city, in office or out, you may always consider me at your side, battling with you for your rights as sanitarians and as public benefactors.

GEOLOGY.

DESCRIPTION OF MARBLE CAVE, MISSOURI.

FURNISHED BY CAPT. J. B. EMERY.

Roark Mountain, in Stone county, Missouri, is the highest point of the Ozark range within a radius of twenty-five miles. It is surrounded by the head waters of Roark Creek, Big and Little Indian Creeks, Fall Creek, and Jacob's Branch, all flowing in different directions. To the south is White River, towards which the mountain slopes; to the north James River. The first is about three, the other six miles from the top of the mountain.

That top is a strip of table land, about one mile long and from an eighth to a quarter of a mile in width; one thousand feet above the level of White River. A magnificent view presents itself from that point. The eye sweeps over range after range of mountains, heavily timbered with oak, black-walnut, cedar and pine, valleys with streams meandering through them. A bracing, invigorating atmosphere. Abundance of game. Springs of pure water, and medicinal springs,

chalybeate, sulphur, etc. Almost every variety of ordinary fruit finds the soil and climate congenial.

Nearly in the middle of the level space on the top of Roark Mountain is a depression, an oval shaped sink, two hundred and fifty feet long and eighty feet at its greatest width. This sink is the mouth of a funnel, standing perpendicular above the mouth of a gigantic cave, called Marble Cave, after the rock by which it is walled in. The mouth of the cave is in the middle of its roof.

The sides of the funnel taper downward, rather steeply, till a depth of one hundred feet is reached. Not so steeply, however, but that one can climb down them along a rugged path. These sides are of huge blocks of flint-rock with earth between, sufficient to afford, at intervals, footing for trees one foot and a half in diameter.

After having gone down the side of the funnel-shaped sink, one comes to another opening nearly oval, thirty feet long and from five to fifteen feet in width, the bottom of the funnel. This opening is at two places bridged over by large rocks, which have fallen down and become wedged in. It really is a hole in the top of the roof of the cave, which roof here is from fifteen to twenty-five feet thick. Now the rock is grey marble. Below one of the wedged-in rocks, a ledge projects, jotting out from the side of the hole in the roof of the cave. A path leads to that ledge. From the ledge one descends by means of a ladder, sixty-five feet long, to the top of a pile of rock, earth and rubbish, rising upward in the shape of an irregular truncated cone, from about the middle of the floor of the cave. That pile is about two hundred feet high. A rough, winding path along its side leads to the floor of the cave.

The cave is nearly circular, in the shape of an inverted bowl, flattened at the top. That flat top is of dove-colored marble and two hundred feet in diameter. The floor of the cave is seven hundred feet in diameter. The roof is about two hundred and fifty feet high. The sides along the bottom are of granite. Above that comes a layer of onyx, mostly white and sixty feet thick; above that thick layers of dove-colored, variegated, brown, red and drab marble, mostly dove-colored; and between the layers of marble are thin layers of flint rock. Between the layers of marble in the sides and the flat marble top of the roof is limestone.

The base of the cone-shaped pile in the cave is from two hundred to four hundred feet in diameter. It comes at one place within a short distance from the wall of the cave and at another leaves a space of nearly five hundred feet. It seems to have been caused by a volcanic upheaval and increased by earth and debris falling down through the opening above. At noon the vertical rays of the sun strike the top, rendering the strata in the roof dimly visible, and more clearly outlining the upper part of the cone-shaped pile. For the rest, the cave is dark.

Countless bats have for centuries been swarming in the cave and through the passages and rooms connected therewith, whenever the weather is cool. The floor of the cave is covered by a layer of guano, the deposit of those bats, and by myriads of carcasses of such as died and decayed long since; which last is evidenced by numerous small bones found mixed in. That layer of guano has

been probed to depth of twenty-five feet and no bottom reached. Guano is also found in stretches on the sides of the cuneiform pile to a height of fifty feet; and further up, mixed with stone and dirt, clear to the top.

Where the foot of the cone is farthest from the wall of the cave, is a huge stalagmite, about fifty feet high, translucent, white and hollow. At its base is an open arch, through which one can climb and ascend on the inside to a height of about twenty-five feet, when one is stopped by a spring of very clear water. This water streams down to a basin hollowed in the bottom of the stalagmite.

Between the stalagmite and the side of the cone is a gigantic block of white onyx, about oblong at the base and nearly circular at the top. It tapers upwards to a height of fifty feet. The width of front and back at the base is forty feet, the thickness thirty feet. At the top, where the shape is circular or almost so, it is eight feet across. Projecting rocks can be used as an irregular stairway for ascending to the top. About half way up is an opening. The block is hollow and divided in cells, through which one can wind one's way. A light carried inside is dimly perceptible outside, through considerable thickness, the onyx being sufficiently translucent for an outsider to follow with the eye the course of the person inside carrying the light. The outside is decorated by water formations in the shape of columns and draperies; and on the stone appear like rude carvings in relief of human faces. This block has been named the "Great White Throne."

From the arched wall of the cave, behind the "Great White Throne," hang down over 1,000 stalactites, varying in length from a few inches to twenty feet and in color, crystalline, white, yellow, and red; here and there interlacing and forming what looks like delicate net-work.

From the top of the roof, where it begins to be vaulted, yellowish stalactites of various sizes hang down in groups. Touched for a moment by the rays of the noon sun, the tips glisten beautifully.

Fifteen passages lead from the cave in various directions, farther into the mountain. Their walls, like those of the cave, are of marble, flint, onyx, and granite, in layers. To any one making the round of the cave, starting from where the wall presents the widest space without any opening, and moving with the wall on the right hand, the rooms present themselves in the following order:

1. The largest, thirty feet wide and fifteen feet high, divided into two unequal parts by a pillar, is the Emery Avenue, after Capt. J. B. Emery, postmaster at Lamar, Mo., the president of the company which owns the cave. This passage is only about ten feet long and leads into a room 250 feet long, thirty feet wide and from ten to twenty feet high, the floor slanting and saddle-shaped near the middle. This room is called the Mother Hubbard Room, by reason of a rock in the shape of an old woman with cape and hood, bending from a stool over a grate, near what seems to be a cupboard in the wall. This room ends in a mass of rock piled up irregularly. Same kind of rock as in the cave, and floor thickly covered with guano. In this pile of rock is a narrow passage through which one has to creep. It is thirty feet long and ends in a room about twenty feet wide,

thirty feet long and forty feet high. This room, during cool weather, is so filled with bats that they completely cover and hide the wall all around, giving it the appearance of black velvet. Whenever disturbed they fly about in such numbers as to put out any light not protected by a lantern, and incessantly flap against one's face. Hence the room is called The Battery. A very thick layer of guano covers the floor. At the further end is a small stream of water, about three inches deep and three feet wide, all saturated with guano, and running onward between rocks. A boy, Dick Powell, son of a member of the cave company, followed the stream for a distance of 100 feet and then, coming to a precipice, turned back. Through the passage from the Battery to the Mother Hubbard Room, a strong inward current of air constantly forces itself. Therefore this passage has been designated as the Inward Wind Passage.

2. A second passage, about three and a half feet high and the same in width, is called the Outward Wind Passage, by reason of a current of air rushing from the cave with such force as to extinguish any light not in a lantern. It has been explored only about 150 feet, at which point progress is stopped by cross stratum of onyx, dividing the passage and rendering it too narrow. A large fire of pine knots once was kindled in it, and the draft carried the smoke off without hindrance. Probably it leads to an opening in the side of the mountain.

3. A third passage, slanting with an incline of 45°, and circular like a hole, three and a half feet in diameter, leads to a room about thirty feet long, ten feet wide and fifteen feet high. This room is called Powell's Room, after T. S. Powell, vice-president of the company, who discovered it. A short straight passage, also a creepway, leads from this to a similar room, in size half of the former. Another creepway connects this second room with a third still smaller, in size about one-third of the first. The floors of these three rooms are vast deposits of guano, depth unknown. A fourth passage leads farther on but has not been explored, because it has been greatly stopped up with guano. The walls of these three rooms are smooth blocks of white onyx and dove-colored and red marble piled up.

4. A fourth passage, in size similar to the former, runs down at an angle of 45°, to an almost circular room about fifteen feet in diameter and ten feet high. This room seems to have been a den of bears, as the ground, also a guano bottom, is strewn with bones of bears. Waste water, from the spring in the cave, runs through this room and into a farther room, visible but not accessible along the stream. The guano is partly spoilt by the water. Rock, marble and onyx.

5. A fifth passage, the most tortuous of all, circular in shape, about 190 feet long, and at some points only two and a half feet high, leads to a room of serpentine shape, not over three and a half feet in height. The floor of this room is brilliant red clay, very strongly impregnated with saltpetre. Here neither bat nor guano is found. But the room, the length and width of which has not been accurately ascertained, is filled with mummified animals. There are bears, panthers, otters, racoons, opossums, wolves, foxes, lynxes, etc., and one specimen of what seems to be an antediluvian animal of the genus pterodactylus. Also

smaller animals, seemingly some kind of monkey. These mummies are in an attitude of repose, as if the animals had come here to die. Hence the room is called the Cemetery. Hair on the dried up skins is well preserved. The roof of the room is marble. The sides, so far as seen, are a glistening quartz, believed to be silicate of zinc, but not yet analyzed. What may be beyond this room has not been ascertained.

6. A sixth passage is located at the rear of the spring. It is about two feet wide and forty feet in height, and tapers toward the top. It really is a crack, about thirty feet long, in the rock, level and straight. Red, white and brown stalactites hang down from the roof. They reach so low that one has to creep under them. It ends in a circular room, about twenty feet in diameter. The roof, about fifty feet high, is conical. Water constantly falls from points all over the ceiling, as if that were a colander or sieve. This creates a perfect shower. The water escapes through interstices between blocks and fragments of rocks which constitute the floor. The sides of the room are enveloped in water-formations, and the sides of the roof are covered with bright, brown stalactites. An immense stalactite hangs from the center. The room is called the Shower-Bath Room. The space below has not been examined. Neither has it been ascertained where the water goes to.

7. A seventh passage has a round opening three feet in diameter, and retains that shape. It winds and at first is level, but soon begins to slope. The ground is strewn with small bones and teeth. It seems to lead to the space whither flows the water from the last described room, but as yet it has been explored for only a distance of 100 feet.

8. An eighth passage is about six feet wide at the opening and three and a half feet high. It gradually increases in height until, at a distance of forty feet from the beginning, it is six feet high. Up to that point it is level; but now it descends and widens, the roof remaining level, until at a distance of 140 feet from the beginning, it is twelve feet wide and forty feet high. The ground is granite and red clay. The passage ends in a room called the Blow Room, after the late Hon. Henry T. Blow, of St. Louis, who in 1869 penetrated thus far and chiseled his name in the wall. The Blow Room is about 100 feet wide, 250 feet long and 100 feet high. The floor, also of granite and red clay, is level in the center but slopes both ways. On one side is a hole forty feet wide, opening upon a precipice 130 feet deep. At the opposite side is a round shaft, six feet across, partly covered by a great slab of rock. This shaft is thirty-two feet deep. It ends in the roof of a nearly level passage, about ten feet high and six feet wide. After having followed this passage in one direction for forty to fifty rods, one crosses a stream of clear water, about ten feet wide and one foot deep. The passage then widens and becomes the cañon of the stream, which one has to cross and recross. Occasionally it gets lower, so that one has to creep. From time to time it expands into rooms, none over twenty feet high, twenty feet wide and varying in length from thirty to fifty feet. This passage has been followed for a distance of two miles, and upwards of twenty rooms have been passed. It is

tortuous, monotonous, has no water formations on walls or roof, descends with the rapid current of the stream, and has in some places a rough, and in others, a slippery floor. The rock is granite of beautiful colors and of a high degree of fineness. The emery rock already mentioned also shows itself in some places. The passage might be followed farther; but has not been yet from lack of time. Bats are still occasionally found. Some guano, but not in beds; probably the water has mostly carried it off. Following from the bottom of the shaft the same passage in an opposite direction, one descends more than when moving the other way. It winds round, and while it continues (about which more anon) soon therefrom branches off another passage. This traverses four rooms in succession, and ends by reaching the bottom of the precipice, first seen from the great gap in the wall of the Blow Room. The four rooms average about twenty feet in height, and vary in width from ten to twenty-five feet and in length from thirty to sixty feet. Three have projecting ledges running all around along the sides, interrupted only by the openings of the passage. One can walk over those ledges as in a gallery. The floors slant and are, as well as the walls and roof, of granite and yellow and variegated marble. Very little guano. Here and there are holes in the floor, showing underneath similar rooms of less height. In these lower rooms are several small, swift streams of very clear water, running in different directions.

The room constituting the precipice is 230 feet high, nearly circular, and seventy-five feet in diameter. It is called the Voice Room, because frequently sounds are heard there, so strikingly resembling human voices that an explorer, on first entering it drew a revolver in self-defense. Probably they are echoes of falling water, and depend on the rush. The lower part of the Voice Room is emery rock, the upper part granite, between which two the top of the precipice, or level of the Blow Room, is about the dividing line. Opposite the passage through which one has entered, is a kite-shaped crack in the wall. This crack runs up about twenty feet. Near the top it is about twenty feet wide, and at the bottom the sides close together in a point. It is the entrance of an almost straight passage which retains that shape, and first descends, at an angle of 45°, but later becomes a little less steep. The crack grows larger at the top and higher, till it reaches sixty-five feet in height and, near the top, forty feet in width; but at the bottom it always remains, coming to a point. Here and there in that bottom are holes affording a view of rooms below, to a depth of about thirty feet. It is all emery rock; no other rock is any longer met with. It leads into what is called the Waterfall Room. This room is crescent-shaped, and about 100 feet high. One enters it at one of the corners of the crescent. From there to the opposite corner is about 200 feet. About the center it is thirty feet feet wide. Near this center, about the middle of the outer line of the crescent, is a recess in the shape of a horse-shoe. The two points of the horse shoe are fifty feet apart, and the curved line between 125 feet. The wall of this recess is perpendicular and sixty feet high. Down it falls, with great force, a large body of water coming from rooms above. One can pass behind the fall; between it and the wall. The spray is such as to extinguish, anywhere in front, a light not

protected by a lantern. The entire floor of the Waterfall Room is covered with beautiful water formations, resembling the figures on a carpet, but standing out in relief. The walls are similarly covered, the formations looking like pails, baskets, etc. In front of the fall are jug-shaped basins, varying in depth from one to two and a half feet, and in width from six inches to three feet, with openings only big enough for the insertion of the hand. The water streams in them, and probably passes out again through small cracks; which matter, however, has not yet been ascertained, nor what becomes of the water. These basins contain white, soft, blind, toothless lizards, from two to six inches in length. The roar of the waterfall, and of other falls below not yet reached, is such as to render conversation in any portion of the room impracticable.

At the opposite corner of the crescent is an ascending passage about four feet wide. The roof of this passage is a continuation of that of the Waterfall Room. The floor is of red clay, very slippery, into which steps must be cut, as the angle is 45°. The passage is nearly straight and about 100 feet long. It ends in a room sixty feet above the level of the floor of the Waterfall Room. This room, which one enters by a turn to the left, is about ten feet high. It contains one large spring and a cluster of smaller ones. In a backward direction it is connected by a passage about forty feet long and four in height and width, with a similar room, also containing springs. This second room is, by a similar passage, about twenty feet long, connected with a third room of the same kind. The two first rooms are about of a size, but the third is smaller. The third room contains the head of the waterfall; and the springs in the rooms last mentioned furnish a portion of the water. These rooms and the connecting passages are together between 300 and 400 feet long. The rooms are about thirty-five feet in width. From the first and second rooms, passages lead to other rooms beyond, but these have not been explored. Water also flows from those unknown farther rooms. The waterfall is fed, not only by the springs above described, but also by a swift, shallow stream, about thirty feet wide, coming through a low cañon. This cañon has been ascended for a distance of about 700 feet, and might be farther explored. The entrances to ten passages, all but one ascending, and with water running through them, were passed. Half of these passages are on one side, and the balance on the other, of the cañon, at very irregular intervals. They have not been examined, except the second to the left, which descends and is dry. That passage is about eight feet wide and four feet in height. Its entrance is dammed by rock and water formations. The passage gradually increases in height, until it reaches ten feet. It winds and is about 200 feet long. It opens on a semicircular room. The descent to that room is very slight. The room is over sixty feet high; greatest width twenty feet; length of outer curve 250 feet. The walls are emery rock and red clay; preponderance of red clay. About one half of the floor is covered with a thick layer of fine guano. The uncovered balance shows the red clay. The entrance is at one end. At the opposite end the wall does not go clear to the top, but runs up to a height of thirty feet. It is a heavy bank of red clay, studded all over with pointed pieces of mica, of

about the length of a finger, glittering like diamonds and soft enough for chewing. About the middle of the outer curve, thirty feet above the floor, in the outer circular side, is a hole, about six feet in height and four feet in width, the entrance of a passage about twenty feet in length, which ends at a precipice of unexplored size. Rocks thrown down that precipice are heard to strike the bottom in the time required to count twenty-one.

Near the clay wall is a winding and gently descending passage, about four feet wide and from five to ten feet high. It leads in succession to three rooms, which average twenty feet in height and twelve feet in width, and are semi-circular, and with arched roofs. In length they vary from thirty to fifty feet. Some guano, but no great quantity. Passage and rooms together about 500 feet long with emery rock and red clay. This passage, always descending, ends in the one which passes the foot of Blow Room shaft. The point of junction is 200 feet from the bottom of the shaft. Between these two points is the entrance of the passage taken when going toward the Voice Room, so that a circuit has been made. The passage in the roof of which the shaft ends, continues beyond the point of junction just described, but has not been farther explored.

This entire part of the inside of Roark Mountain, is one vast labyrinth of caves and passages, the one above the other and as yet only partly known.

9. A ninth passage has its entrance fifteen feet above the bottom of the cave. That opening is wedge-shaped; the base is three feet, and the sides come together at a height of ten feet. The passage retains that shape. It is level and smooth at the bottom, but the sides are rough and only a small sized person can enter. This passage is sixty feet long. It leads to and ends in a small triangular room. The floor of the room is an isosceles triangle, each side twenty feet. The roof is pyramidal and about fifty feet high. From the top stalactites, clear as crystal, from one to five feet long, hang down. The sides are covered with crystals of translucent onyx. On the bottom is but little guano, as the bats seem to prefer smoother roofs and larger rooms. Water formations so completely encrust the walls that the nature of the rock has not been ascertained.

10. A tenth passage is a crack in the wall of the cave, near the point where the foot of the cone-shaped pile comes closest to that wall. The crack is wedge-shaped and seventy feet high and three feet wide at the bottom, the sides coming together at the top. The passage thus made is rough from protruding flints, and descends at an angle of 45°, until, at a distance of sixty feet from the starting point, it is intersected by a precipice forty-six feet deep. Across the precipice, leaving a gap of about six feet, is a projecting ledge about two feet thick. The passage continues across this ledge, but becomes much narrower and has not been further examined. Descending the precipice with a ladder, one finds an oblong room about fifteen feet wide and twenty feet long. The top is on a line with that of the passage, except in so far as the projecting ledge mentioned intervenes. The bottom is very thickly covered with guano. Sides perfectly plumb and as smooth as masonry, of dove-colored marble. In the wall under the ledge is a hole about five feet high and three feet wide, through rock

two feet thick. This hole gives access to another similar room, the floor of which is on a level twenty feet lower. That room too, is oblong. It is fifteen feet wide twenty feet long and twenty-five feet high. Walls like those last described. In both these rooms the layer of guano which covers the floor is at least ten feet thick, as with a pole of that length, bottom could not be reached. The first of the rooms is called the Jones Room, after Dr. T. Hodge Jones, secretary of the cave company, who was the first to explore it. The second the Arnold Room, after F. D. W. Arnold, treasurer of the same company; for a similar reason.

11—15. Where the foot of the cone approaches closest to the wall of the cave is a recess in that wall. Five passages, all low and narrow, lead from that recess. They are about three feet high and three to four feet wide, and slope gently downwards. Each leads to a series of small rooms of irregular shape. Only nine of these rooms have been visited. Passages and rooms both have been but imperfectly explored. The rock in them, and even in the recess of the cave, is of an alkaline nature and crumbling. Everywhere are loose stones and debris. The rock easily slackens and pulverizes. An acid causes it when pulverized to effervesce. The application of water hardens it into the likeness of plaster-of-Paris. The color is light gray. It has not been analyzed. No guano here. The bats avoid this place; probably because the rocks in the roof are apt to tumble down. This same circumstance has retarded more thorough exploration.

The temperature of the cave is 56° F. during the hottest season. It rises slightly in rooms and passages below. Whenever the weather is cool, a person sitting on the top of the cone at the foot of the ladder, can see myriads of bats sweeping down the mouth of the cave.

The "Wilderness Road," a wagon-road leading from Springfield, Mo., into Arkansas, passes within four miles of the cave. These four miles can be traveled over by a remarkably good natural road, with beautiful scenery all the way. Springfield is forty miles from the point where this road strikes the Wilderness Road.

Forsythe, the head of navigation on White River, during the high water of spring, is fifteen miles in a straight line from the cave. It is the county seat of Taney County. Galena, the county seat of Stone County, is also fifteen miles off, and Ruth, distant six miles, in the same county, is the nearest postoffice.

Capt. Emery, in a private letter, says that while the above description may be in some points slightly overdrawn, it is in the main very correct, and that "not half of the wonders of the cave are told."—[ED. REVIEW.

A NATURAL CURIOSITY.

About two miles south-east of Santa Paula and near the foot of the mountains is a natural curiosity. The rocks, which were once doubtless impregnated with petroleum, have undergone oxidization, all the bituminous matter having been burned out. They consist of horizontal strata of sandstone, some coarse and others fine grained. The oxidization bears evidence of having taken place ages since and to have extended to a great depth. As a result of these internal fires, a circular district, some five or six hundred yards in diameter, has sunk to the depth of about one hundred feet, leaving an opening on the west side. A conical hill rises in the centre to the height of nearly one hundred feet, capped with sandstone. The perpendicular walls extend nearly around the depression, showing a fine exposure of stratified rocks of various colors. Those containing most bituminous matter are left more highly colored and present a pleasing contrast to the gray layers that were less affected by the heat. About a half mile from this amphitheater and a thousand feet higher up the mountain is a solfatara similar to what this one was at the time, and from which hot air and steam are still escaping. Mr. George Richardson, who owns the land upon which the solfataras are situated, informs us that the living one was much more active sixteen years ago when he first came to this place. The places described are well worth visiting.—*Ventura Free Press.*

ENGINEERING.

THE NICARAGUAN CANAL.

ADMIRAL DANIEL AMMEN.

While there are other considerations which might determine our government to execute a great work such as the Nicaragua Canal at even a commercial loss, it is obvious that a limit exists beyond which action should not be taken; such for example, I would say, as the sea-level canal at Panama, involving primarily from its physical conditions enormous outlays, entailing great uncertainty of results, and certainly great outlay for its maintenance in a navigable condition, and from time to time serious delays from land slides into the canal. The subject presents itself as abnormal, distasteful, and unnatural if not considered commercially. What will the canal cost, and what for its maintenance? What will be the minimum traffic, and what period of time will be necessary to execute the work?

On the present location the engineer's estimate for labor and material is

$41,193,839. In every construction of this kind what is known as a contingent fund is requisite for machinery, superintendence, unforeseen difficulties, delays, interest on money, etc. More recent examinations assure the fact that the canal location can be very materially improved, but as this has not yet been effected instrumentally, no reduced estimate for labor and material is admissible, and, although considerable will result, it will not be taken now into account. Over the present line of location the cubes are well ascertained, and the character of the material to be excavated is approximately known. The estimate for dredging where the material can be flumed into its place of deposit is thirty-five cents per cubic yard. Improved machines make this estimate excessive, and there will be not less than fifteen miles of dredging of the fifty-three miles requiring excavation, if further location does not reduce this ten miles or more, which is highly probable. On the eastern section 24,064,053 cubic yards in earth is given at thirty-five cents per yard. More than half of this can be dredged and flumed to its dumping ground at a cost not exceeding one-third of the estimate. Rock excavation in the San Juan River is given at $5.00 per cubic yard, when it can be contracted for at a considerably less figure. The reader will bear in mind that all of the engineer's estimates were doubled by the canal commissioners appointed by the President, and will also be here in stating the maximum cost of the canal at $82,387,678.

The engineer's estimate for earth was thirty-five cents; for stiff clay, forty cents, and for rock "in the dry," $1.25 to $1.50 per cubic yard. The dumping grounds throughout are very convenient, as they may well be on a lock canal, and there are no cuts of more than forty-five feet in depth above the water level, and they are quite short. The mean cut above the intended water level of the canal is less than ten feet, and the deepest fills are three feet below it. As all of the excavations can be made with sufficient natural drainage, except the parts that can be dredged, the most economic conditions exist for the execution of every part of the work, and this would not be the case were it a sea-level canal, where blasting and removing rock must be a slow and expensive operation.

The engineer's estimates were not made to favor the construction of the work; they were made for the government. With a contingent of twenty-five per cent, which perhaps would prove too small, it is not at all improbable that the cost of the canal, when executed in the best manner, may not exceed $65,000,000, interest included. Without sacrificing economy nearly every part of the construction can be entered upon at the same time, and for this reason the canal may be open for traffic within five years from this date.

Admitting the maximum figure for construction instead of the last named, let us consider a minimum figure of tonnage and of transit dues. Of immense importance to us prospectively is our coasting trade which would pass through it. One million tons for the present would be a low estimate, and in less than half a century it would be five times that amount. The grain product for export to Europe of the north Pacific Coast now exceeds 2,000,000 tons, and the vessels partly laden with iron and coal and partly in ballast, going through the canal for

cargo, would be not less than 1,000,000 tons. Then we have the traffic to and from Japan, northern China, the Phillipine and Sandwich Islands, the islands of the south Pacific, New Zealand, and Australia, to and from our Atlantic Coast and European ports. One million tons would be a small estimate. We have then 5,000,000 tons plainly in sight as soon as the canal is open for traffic, and will leave the traffic of the west coast of South America to the Panama Canal; upon the hypothesis that it will actually be completed. With canal dues of $1.00 per net ton and deducting $1,000,000 for maintenance of the canal and for towage, we have $4,000,000 for dividends, which is a small fraction below five per cent on $82,378,678, the maximum cost of the canal arrived at by doubling the engineer's estimates.

But a traffic of enormous proportions will develop from the construction of the canal, without which it would be impossible; the timber traffic from Puget Sound extending northward even to Behring's Strait, to our eastern coast, and to Europe. In order to have a conception of what this will amount to, let the skeptic visit the Liverpool steamer Oregon and examine the thirteen splendid timbers in bright colors from the State of Oregon, with which that vessel is finished. The yellow cedar when finished is as beautiful as satin, is as easy to work as cypress, and surpasses oak in durability. All of these timbers are superb and are to be found in enormous quantities convenient for shipment, and can be put on board of sailing vessels and auxiliary propellers at small cost and with munificent profits, and can be sold in Europe at certainly below the market price, at this time, of ordinary pine plank; add to this the constantly increasing wine product of California, and we see at once what a mine of wealth the construction of the Nicaragua Canal will bring to all of the inhabitants of the west coast, and what an amelioration it will prove to those of our east coast and to Europe.

We may well conceive that the earnest commencement of the construction of the canal would serve at once to establish our ship-building interests and our iron trade, upon which almost all the prosperity of our industries depends, and thus revive the entire traffic of our country. We see in this timber traffic that the canal dues will soon have to be reduced to fifty cents per ton to avoid a revenue far above the usual rate of interest paid on an investment.

Such persons as may object to a government construction of the work are reminded that our citizens holding a concession were unable during a period of years to obtain of Congress a simple act of incorporation. It is idle now to inquire into the influences that prevented; the question now is presented in its simplest form.

Statesmen may perceive the advantage of our Government constructing the canal rather than abandoning it to another government. They may perceive, too, that after developing the commercial certainty of this canal the nonconstruction of it by us will not prevent its construction by others. Were it only for the purpose of silencing the question politically, it would seem cheap to construct it were the cost ten times the amount of the sum named. It would prove a far

better economy than spending double that amount in war, which would seem altogether a probable result from non-action at this time. If we do not now determine on the construction of the canal ourselves, we certainly would have small reason for complaint were Nicaragua to grant a similar concession to any other power to that agreed upon with our Government.—*National Republican.*

METEOROLOGY.

METEOROLOGY OF THE MOUNTAINS AND PLAINS OF NORTH AMERICA.

CAPTAIN SILAS BENT.

We extract the following from an address delivered at St. Louis, Mo., November 18, 1884, before the Cattle-Growers' Convention, upon the subject "Meteorology of the Mountains and Plains of North America, as Affecting the Cattle-Growing Interests of the United States." Captain Bent has given the subject of meteorology deep study, and his views carry weight with all western people, at least.—[ED. REVIEW.

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These plains extend from Texas to Canada, about twelve hundred miles in length and with a width eastwardly from the base of the Rocky Mountains of about three hundred miles, making an area of 360,000 square miles, or upwards of 250,000,000 acres of land which, with rare and limited exceptions, are fit only for grazing, and can never be profitably used for any other purposes. The laws should, therefore, be amended by adding another, or "Pastoral," grade to the Public Lands Schedule, and with authority for leases alone to be made to persons wanting such lands in tracts of not less that 20,000, nor more than 300,000 acres to each lessee, for terms of twenty years, which would prevent these lands being monopolized by a few persons to the detriment of others, and would yet give to the tenants security in those proprietary rights necessary to prevent trespassing by others, or disturbance from Government agents or officials.

As I have before intimated, these lands can never be converted into agricultural lands, notwithstanding the various schemes proposed from time to time for their irrigation and reclamation from agricultural sterility; for there are physical causes for that sterility which neither the power nor the ingenuity of man can change, and it has been thought that a brief discussion of these causes might not be uninteresting to the members of this Convention, and I have been asked to give you views in regard to them.

To do this will, of course, involve a wider range of investigation than if the

simple facts and conditions of the problem were accepted without going back to their origin or cause through the meteorological processes by which these facts and conditions are brought about.

I will first call your attention to this skeleton map of North America, where only the main ranges of mountains, chief lakes and principal rivers are laid down, other details being omitted so as to prevent confusion.

The principal range of mountains extending through Central America into Mexico is a continuation of the Andes of South America. In Mexico, however, these mountains are known as the "Sierra Madre," or "Mother Range," and which throws off two branches—one to the northwest along the Pacific Coast into California, where it is known as the "Sierra Nevada" or "Snowy Range," and which runs thence up into Oregon, where with a lower altitude to the range, it assumes the name of the "Cascade Mountains," and where it is broken into a number of detached, isolated but majestic peaks, such as Mounts Jefferson, Hood, Adams, Ranier, St. Helens, etc., etc., which stand as hoary sentinels surpliced in eternal snow to mark the gateways through which the moisture-laden winds from the Pacific Ocean gain access to the heart of tne continent.

The other and in many respects the grander branch from the Sierra Madre is the Rocky Mountain Range, which runs almost due north about the 110th and 120th meridians of longitude, until reaching the parallel of 45° N. latitude, where this range sinks to an elevated "divide" of from 6,000 to 8,000 feet above the level of the sea.

Lying between these ranges, and extending from the Sierra Madre to the Yellowstone Park, lies a plateau or plain of comparative sterility and barrenness, comprising much of the territories of Utah, Arizona and Nevada.

With this preliminary description of the map, I shall now proceed to discuss some of the meteorological phenomena that have a direct bearing upon the question before us.

It is generally believed that the sun is the direct evaporator of humidity and especially of the ocean waters, and that the evaporation from the oceans is mostly from the equatorial regions of the earth, and that the vapor from this evaporation is transported by the winds through the upper regions of the atmosphere directly north and south, to its points of distribution in the temperate and frigid zones.

This, however, I think is a fallacy, and that in reality, notwithstanding the enormous evaporation that does undoubtedly take place in the equatorial regions, by far the greater part of that evaporation is precipitated back to the earth's surface within the tropics, and that by quite a different process are the regions of the earth beyond the tropics supplied with water from the heavens.

The sun's rays being more nearly vertical within the tropics, have so much the more heating power, and the surface waters of the oceans there are thus brought up to a general temperature of 88° F.; from whence this heated water is carried north and south to the earth's extremities, by grand ocean streams, which are the life-giving arteries of the oceanic and inter-oceanic circulation.

Of these streams there are four, the two grandest and greatest of which are thrown off to the southward, from the equatorial currents of the Pacific and Indian Oceans; whilst the remaining two are thrown off northwardly from the tropics into the north Atlantic and Pacific Oceans. The first of these latter is the Gulf Stream, whose general character is familiar to us all. The other is the Kuro-Siwo, of more recent discovery, which starts from the southeast coast of China, and running northeastwardly with a velocity of from thirty to eighty miles a day, and losing only 1° of warmth for every 300 miles that it travels, washes the south coast of Japan, and spreading a mantle of tepid water of upwards of 70° of temperature over the surface of the north Pacific, envelops the whole west coast of our continent from Behring's Straits to the Equator with its genial warmth, and gives to that region the delicious climate which is now becoming so well known to us all.

Now, whilst the sun by its heat in the tropics has prepared these waters for rapid evaporation by giving to them their high temperature, yet the sun itself cannot and does not evaporate any portion of them, except through the medium of the atmosphere. And the power of the atmosphere to produce this evaporation is in exact proportion to its low temperature and its dryness as compared with the water at the time of its contact with these tepid waters from the Equator.

The prevailing winds in the temperate zones are from the westward. The west winds which come to the north Pacific from the plains of Central Asia and Siberia are cold, contracted and dry, with a temperature frequently below the freezing point, so that when they reach the tepid waters of the Kuro-Siwo they at once respond to the warm and expanding influence of these tropical waters, and as they expand drink up by evaporation prodigious quantities of the latter, which, as invisible vapor or fogs, are borne eastwardly across the surface of the ocean to the west coast of our continent.

That portion of these winds that reaches our coast about the mouth of the Columbia River are chilled by the Cascade Mountains, and made to yield such quantities of rain as to have produced a forest growth of vegetation so rank and majestic as to be unrivalled by any other forests of North America; and just north of the Cascades come the open gateways through the mountain ranges, guarded only by the detached and hoary peaks before named, between which these west winds carry their burdens of warmth and moisture to gladden and fatten the face of the interior of the continent, but which on their way pay such tribute to these majestic sentinels as to clothe and crown them in the purity of everlasting snow, and then reach the elevated region of the Yellowstone Park with still abundant moisture, which is dealt out from their hitherto invisible treasures with such royal profusion as to give birth to and keep in perennial flow the grandest system of rivers on the face of the globe, viz: the Columbia, McKenzie, Saskatchawan, Assiniboine, Yellowstone, Missouri and Colorado, which, radiating north, east, south and west from this immediate region, and with courses of thousands of miles, each distribute their waters into all the oceans surrounding

the continent. This may, therefore, be not inaptly called the "*Water Dome of North America!*"

Stretching eastwardly from this "Dome" to the mouth of the St. Lawrence River on the Atlantic Coast, lies a declining ridge, from which waters run north into Hudson's Bay, and south by the Mississippi, Illinois and Ohio Rivers and their tributaries, into the Gulf of Mexico, and east of the Alleghenies by the Potomac, Delaware, Hudson, Connecticut and other rivers into the Atlantic Ocean.

Besides all these mighty rivers that have their geneses in the direct pathway of these west winds across the continent, and cradled upon the crest of the ridge just described, lie the great Lakes of Superior, Michigan, Huron, Erie and Ontario, which alone are estimated to contain one-half of all the fresh water resting upon the face of the earth, and which, notwithstanding the necessarily enormous drain from them by evaporation, yet have always such a surplus of water as to keep in unvarying flow from them the majestic St. Lawrence River.

Now the waters which supply the rivers radiating from what I have termed the "Water Dome," all come from this west wind from the Pacific, as I believe do also those which supply the other rivers in the Mississippi basin west of the Allegheny Mountains, together with those that fall into and make the great lakes. Whether or not the waters that go into the rivers east of the Alleghenies come from the same source is doubtful. I think, however, that through local agencies, they come from the gulf stream of the Atlantic. Yet it is not unreasonable to believe and affirm that by reason of the waters that do come from the prevailing west winds from the Pacific that it is the *Kuro-Siwo of the Pacific that irrigates and fructifies the heart of the continent of North America.*

Now it may be asked, what has all this to do with the aridity of the alkaline plains of Colorado and New Mexico? Very much, as I shall endeavor to show, by first calling your attention again to the water supply that is carried under the wings of this west wind from the Pacific Ocean and distributed nearly, if not quite, across the continent (when not interrupted by the condensing power of intervening mountain ranges,) since that is the gauge by which the quantity of water carried by these winds can be measured; and if found in one portion of these winds, it is not unreasonable to believe that other portions of these same winds carry a corresponding quantity. But let us now see what becomes of that supply from that portion of these winds which strikes the land south of Oregon, and which, being slightly chilled by the coast range of mountains and hills, give out moisture enough to envelope the coast with fogs and clouds during many months of the year. Passing thence into the interior, these winds are thrown upward against the cold flanks and peaks of the Sierra Nevada, where being condensed, they crown the latter with their coronets of eternal snow. Descending the eastern slope of the Sierra Nevada Range, these winds reach the plateau of Utah and Arizona before described, so robbed of moisture that the earth's sterility is but the evidence of its unslaked thirst.

Continuing eastwardly, these west winds then climb the western slopes of the

Rocky Mountains, but without moisture enough in them to clothe with vegetation the rock-ribbed walls whose sombre and rugged nakedness attest the infrequency of rains upon them. Still the altitude of these mountains is so great, and therefore so cold, that their supreme peaks wring from the shrinking winds what little moisture remains in them, to add sparkling coronets of snow also to their majestic heads. But these winds, pitching thence down the eastern slopes of the Rocky Mountains, reach the plains of Colorado and New Mexico so completely dry as to be unable to give forth even a morning dew, and hence the alkaline sterility of these plains, which no human intervention can change or alleviate.[1]

Now I hope it has been made apparent that these plains, as well as the plateau of Utah, Nevada and Arizona, owe their sterility to no accidental nor remedial cause, but to the immutable laws of Nature, which are not to be changed by man, and that these lands, as they stand, and will forever stand, are not fit for agricultural cultivation, except in rare localities along the water courses, but are especially fitted for grazing and cattle growing, and in my judgment should,

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1 If this meteorological hypothesis is correct, then similar phenomena should be found on the other continents.

Let us see if that is the case.

The west winds which we have followed across North America, on leaving our eastern shores, are cold, compact and dry, but as soon as they reach the tepid waters of the Gulf Stream, they at once respond to their warming influence and rapidly expand, and in expanding, take up by evaporation enormous quantities of water from the ocean, which they carry as invisible vapor or fog eastwardly across the Atlantic, to clothe the British Islands and Western Europe with their emerald robes of vegetation. Then that portion of them that is intercepted by the Alps is chilled and contracted so as to cap these mountains with perpetual snow, encircle them with profound lakes of marvelous beauty, and give birth to and feed the splendid system of rivers which, radiating from this "Water Dome" of Europe, discharge their waters into all the surrounding seas. Among these latter may be named the Elbe, Rhine, Saonne, Seine, Rhone, Po, Adidge and Danube.

The more northerly portion of these winds from the west, deflected somewhat by the Carpathian and Altai Mountains, pass eastwardly across Northern Russia and Siberia, and carry in their wings the water that gives birth to and feeds the Obi, Yennessi, Lena, and other grand streams that empty into the Arctic Ocean, and finally reach the Pacific as the cold, dry winds first spoken of.

It may be said, therefore, that the Gulf Stream of the Atlantic irrigates and fructifies the continent of Europe and Northern Asia.

Southern Asia receives its humidity from the tepid waters of the Indian Ocean, by means of the northeast and southwest monsoons, which prevail there.

Africa, being a tropical continent, is traversed by the trade winds, which blow from the eastward. These winds, saturated with moisture by evaporation from the hot waters of the great equatorial current that strikes the east coast of Africa, after its journey of 15,000 miles along the Equator from the west coast of America, sustain the rank vegetation which belts this continent in the tropical region, from the Indian to the Atlantic Ocean; crowns the mountains of the Moon with the magnificent lakes of Albert and Victoria, Nyanza, Tanganika and others, and keep in perennial flow from this "Water Dome" of Africa the majestic Nile, Congo and other rivers radiating from thence to the surrounding seas.

The great equatorial current of the Pacific and Indian Oceans, therefore, irrigates and fructifies the continent of Africa, through the agency of the trade winds.

In the same way is South America irrigated and fructified from the equatorial current of the Atlantic, by waters evaporated from it by the trade winds, from which their moisture is wrung by the cold flanks and yet colder summits of the Andes, from which flow into the Atlantic waters, the Orinoco, the Amazon, and the Rio de la Plata, with their myriad of tributaries; but when these winds have scaled the Andes, the extreme cold of the latter has so contracted and wrung from them all their moisture, that when they pitch down upon the west coast of Bolivia and Peru, they are as rainless as those arid winds which cause the alkaline plains of Colorado and New Mexico.

as a whole, be set aside by the Government for the encouragement of that industry alone, since the watercourses and water privileges are imperatively required by the ranchmen, and without which all the rest of the grazing plains are practically worthless.

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ST. LOUIS, MO.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Jan. 20th to 31st.	Feb. 1st to 10th.	Feb. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	-10°.	-16.75°	-17.5°	-14.7
Max	45°.	50°.	31.	42.
Min. and Max	17.5°	16.75°	6.7	13.65
Range	55°.	76.75°	48.5	56.75
TRI-DAILY OBSERVATIONS.				
7 a. m.	11.4	23.1	-9.5	8.3
2 p. m.	21.0	31.1	16.7	24.6
9 p. m.	15.5	24.7	9.4	16.5
Mean	17.1	25.9	8.6	16.5
RELATIVE HUMIDITY.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Mean	. .	. .	. .	. .
PRESSURE AS OBSERVED.				
7 a. m.	29.219	28.905	29.080	29.068
2 p. m.	29.116	29.082	29.132	29.110
9 p. m.	29.192	29.018	29.139	29.116
Mean	29.176	29.001	29.117	29.099
MILES PER HOUR OF WIND.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Total miles	2765	3737	3024	9526
CLOUDING BY TENTHS.				
7 a. m.	6.3	5.6	3.0	4.9
2 p. m.	2.5	3.5	2.3	2.8
9 p. m.	4.4	5.0	4.9	4.7
RAIN.				
Inches	0.54	0.03	0.3	0.60

Snow storms occurred January 22d and February 8th, 14th and 19th. The fall was only two or three inches at any one storm. The prevailing winds as usual at this season have been northerly. "Blizzards" prevailed January 27th and February 9th.

From January 20th to February 20th, the period embraced in this report, there has been steady cold weather with but little snow.

On the 10th of February the temperature was −16.75°, and on the 16th it was −17.5°. These were the lowest temperatures recorded this year to the present date. The 10th was the coldest day, the usual mean of the three regular observations being −7.08°.

A comparison of temperature observations of the last few years for January and February may be of interest:

	JANUARY.			FEBRUARY.		
Year	Min.	Max.	Mean.	Min.	Max.	Mean.
1881 . . .	−11.5°	44 °	16.9°	− 6 °	46°	23.0°
1882 . . .	8.0°	50.0°	30.6°	9 °	68°	39.2°
1883 . . .	−21.0°	47 °	17.8°	−21.0°	68°	25.7°
1884 . . .	−22.0°	59 °	99.7°	− 5.0°	67°	28.8°
1885 . . .	−14.5	65 °	17.2°			

If February continues cold for the next seven days these two months in the present winter will be the coldest of the past five years. The extreme low temperatures of 1883 and 1884 have not been reached, but the below zero days have been more numerous, and the mean temperature lower.

THERMOMETERS.

The severity of the past winter has invested thermometers with an unwonted interest, and it may not be unprofitable, at least to younger readers, to devote a short time to a discussion of the various kinds in most ordinary use.

As the expansion and contraction of the substance in the thermometer-tube indicates the amount of heat or cold prevailing, the definition of heat as a very rapid reciprocal motion of the small particles or molecules of matter is very appropriate, for heat expands all bodies, probably by producing more commotion among and causing their molecules to occupy a larger space. Liquids expand more than solids in proportion to the heat applied, and hence are ordinarily used rather than solids for thermometrical purposes; though some of the latter are probably more accurate and delicate, but less adapted to the more common uses of the instrument. Thermometers are based upon the facts that heat expands substances and that the same substance always possesses the same volume at a given temperature. Hence the liquid within the thermometer-tube should increase in volume to a much greater extent than the substance of the tube itself; otherwise it would not rise, but merely fill the expanded tube as before the heat was applied. Mercury and alcohol are the liquids used in the thermometers of the present day. In earlier times the air-thermometer was used, but of course was very unreliable as a heat measurer.

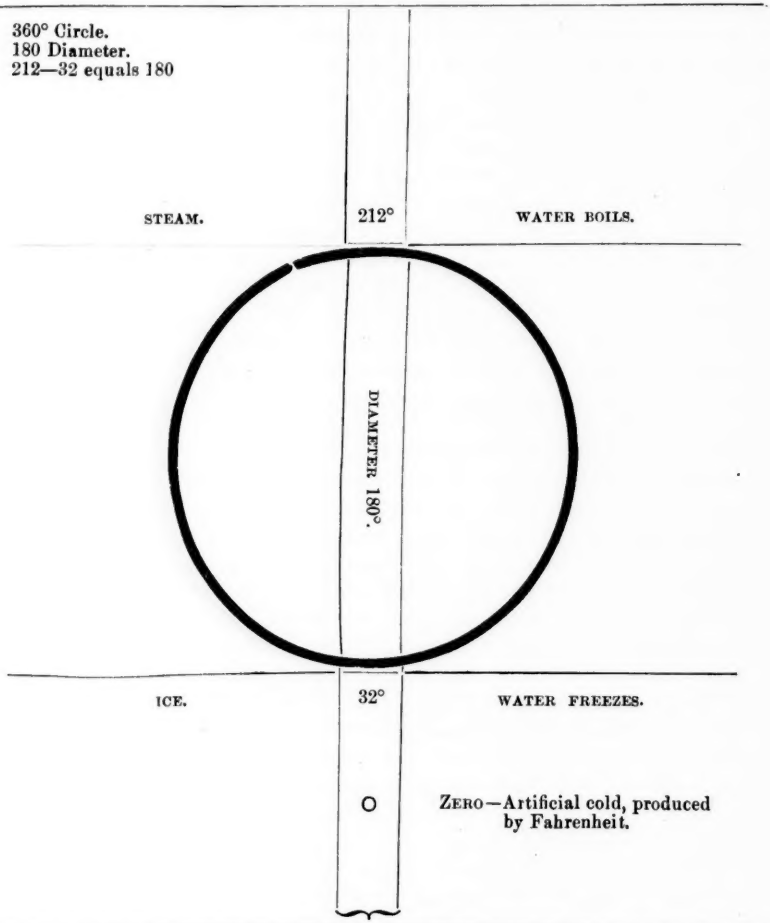
The thermometer was invented in the 17th century, and is attributed variously

to Galileo, Sanctorius of Italy, Drebbel of Holland, and to Robert Fludd. It seems probable that Galileo invented it—i. e. the air-thermometer—about 1602, for Castelli in 1638 says that Galileo had shown him one more than thirty-five years before. It was of glass, with a bulb "about as large as a hen's egg and a neck two palms long, and as narrow as a straw." A rude form of the liquid thermometer was invented in 1655 or 1656 by the members of the Florentine Academy, which possessed the advantage over the former of being hermetically sealed and not being affected by the pressure of the atmosphere. Edmund Halley, the English astronomer, introduced mercury in place of alcohol in 1680, though some writers give the credit of this use to Reaumur.

The scale of degrees fixed by the Florentines had for its fixed points the cold of snow on ice, and the greatest heat known at Florence, both rather variable points. Von Guericke, an experimental philosopher of Magdeburg, Germany, was the first to propose the freezing point of water as the lower limit of the scale, and Isaac Newton seems first to have discovered or made use of the facts that a thermometer placed in melting ice always indicates the same temperature and boiling water, when under a given atmospheric pressure, always has an invariable temperature. These points have been universally adopted by thermometer-makers as being most nearly invariable and the most convenient in practice. To find the freezing point, the bulb and tube are immersed in melting pounded ice or snow to nearly the height to which such cold will lower the column, until both mercury and glass are brought to the freezing temperature—the contraction of both thus being secured—and this point is marked on the glass. Inasmuch as water boils at various temperatures, dependent upon atmospheric pressure, purity of the water, the kind of vessel used and the state of the surface of the water, it has been found more accurate to take the temperature of the steam arising, which does not vary with these conditions. Accordingly the tube is held in the steam arising from boiling water at an atmospheric pressure of 29.92 until both glass and mercury are at the same temperature, when the point indicated is also marked.

Having secured these two fixed points, the graduation of the instrument is easy. The principal scales in use are Centigrade, Reaumur and Fahrenheit, the first having been proposed about the year 1741 by Celsus, who took the freezing point as the zero and the boiling point as 100°. This scale is most commonly used by scientists, especially in Europe. Reaumur established his zero at the freezing point and 80° as the boiling point. His thermometer is much used in Germany. Fahrenheit fixed upon 32° as his freezing point and 212° as that of boiling water, placing his zero at 32° below the freezing point. Various reasons are assigned for these differences in the scales. None, however, has been offered for that of Reaumur. As to that of the Centigrade, it is stated that according to the historical notes contained in the meteorological observations of Lafou, President of the Meteorological Commission of Lyons, the first thermometer ever seen there was exhibited in 1736 by Duhamel. This thermometer was constructed with alcohol according to the scale of Reaumur. Christin, a member of

the Lyons Academy substituted mercury for the alcohol, introducing a quantity whose volume might be represented by 6600 at the temperature of freezing water. Having raised this to the temperature of boiling water he found the volume of the mercury increased to 6700, or 100 parts. This suggested the division of the tube between these fixed points into 100°; and this, according to this authority, was the origin of the Centigrade thermometer; although as before stated, its invention is generally credited to Celsus about six years later.



Fahrenheit kept the reason for his graduation of the thermometer a secret, and it has been supposed that his zero point, 32° below freezing, was the lowest

artificial temperature he was able to produce, or perhaps the lowest natural temperature observed by him in Iceland, but recently a novel explanation has been published by an anonymous writer in the Ohio State *Journal*, which is described and illustrated as follows:

Fahrenheit was a mathematician and knew that a circle was divided into 360°. He found that steam and ice were the most natural fixed points in temperature, at opposite poles. He therefore naturally divided the distance on his glass tube between ice and steam into the number of degrees in the diameter of a circle, which is 180°. He wanted an instrument which could be cheaply made and which would measure above steam and below ice, so far as would be commonly used in everyday life. He found that artificial cold could be produced which would cause the mercury to fall just thirty-two of the spaces he had marked off on his glass between ice and steam, and he there, whether sensibly or not, placed his zero or point from which he would count. Hence ice, or freezing, is 32° above, and steam or boiling water is the diameter of his circle, or 180° above ice, or 212° above zero. This may appear very *novel and ingenious*, but its utter absurity is apparent when we remember that the diameter of a circle is not 180°. We only refer to it here because we have seen it prominently copied in respecta- and influential newspapers.

In converting degrees of one thermometric scale into those of another the following formulæ may be used:

Centigrade	Degrees	$\div 5 \times 9 + 32$	=	Fahrenheit Degrees.
Reaumur	"	$\div 4 \times 9$ "	$32 =$	" "
Fahrenheit	"	$-32 \div 9 \times 5$	=	Centigrade "
"	"	$-32 \div 9 \times 4$	=	Reaumur "
Centigrade	"	$\div 5 \times 4$	=	" "
Reaumur	"	$\div 4 \times 5$	=	Centigrade "

Mercury expands quite regularly between —36° and 212° F. Above 212° the expansion is less regular and the indications less exact. As mercury boils at 660° F., the limit of the scale in this direction is sufficient, but since it freezes at —38° F., alcoholic thermometers must be used for lower temperatures, for this liquid has never been frozen.

Thermometers for maximum and minimum temperatures have been invented by several persons. They are self-registering, and this is effected by a small index within the tube which moves with the mercury in one direction and not in the other.

BIOGRAPHY.

PROFESSOR BENJAMIN SILLIMAN, JR.

H. E. SADLER.

The death, on January 14th, of Prof. Benj. Silliman, "Young Ben" as he had not ceased to be called though he died in his sixty-ninth year, has not been chronicled in the dispatches of the western press. This was, perhaps, to be expected, for Prof. Silliman was in no sense a leader of scientific thought. He had hit upon no such discoveries as those by which Henry opened the way for the telegraph or by which Bell has produced the telephone. He had not pushed speculation to the limit of human reason. He had not been the founder of any school of philosophy. Even in his chosen field of chemistry it has fallen to his colleagues, to Cooke, to Gibbs, to Lawrence Smith, to extend the written laws of nature and make the broader generalizations.

And yet who is left behind to whom the cause of science in America is more indebted? While acting as assistant to his father, so early as 1842, when there were yet no schools of science in this country and when even in our best colleges such instruction was given only by lectures, he fitted up a laboratory at his own expense and gathered about him a few earnest students in physical science. The dinginess of the "old lab" on the Yale campus, whose unloveliness associations have hallowed, and the atmosphere of the college green, supersaturated with Greek, would have stifled a less vigorous shoot, but after five years this bud of promise struggled forth into light and blossomed. In 1847 the Corporation named Tutor Silliman "Professor of chemistry applied to the arts," organized the Yale Scientific School, enrolled his students on the college catalogue, and appointed one of them, the lamented Jno. P. Norton, professor of Agricultural Chemistry. No longer quite single-handed, but still without other than his private resources, he engaged and equipped a larger building and made room for the students who came flocking in, zealous in the new departure. And of them all, how many drew from his untiring enthusiasm the elements of their success; the genius of hard work, the love of learning and of truth, the ambition to contribute to the world's store of knowledge, the spirit of research? How many, too, of those early disciples have continued in the paths then taken, not without reward to themselves and gain to us all. Samuel W. Johnston, Brewer, the lamented Norton, Geo. K. Brush, Daniel C. Gilman, such are the names these memories recall.

An educational revival of this character could not wait long for recognition and support. Under the skillful management of Prof. Silliman, endowments came in quick succession, and when he was called to Louisville University this

offspring of his heart and labors had, by the benefactions of Sheffield, been placed on the high road to prosperity. Immediately other scientific schools, technological institutes, and industrial colleges, began to follow in the lead, until to-day we see them scattered as widely as our common schools.

Yet this was not all, for Prof. Silliman continued a teacher to the end; nor should we forget that physicists like George F. Barker were his pupils, that naturalists like Marsh own his guidance, and that through his influence, perhaps more than any other's, the munificence of the great philanthropist laid deeply the foundations of the Peabody Museum, with its already startling achievements.

But others, whose evidence is not hearsay, are telling more vividly the story of the debt we owe him. After all, lighting the fires of that educational revolution of the fifties was not furnishing the fuel, nor could the momentum of the new engine on the highway of learning be maintained by projecting into it the Nortons and the Gilmans. Science was yet to be popularized and the *raison d' être* of technology must appear.

Probably no chemist in America has so often acted as consulting expert. New and great industries, like petroleum, have arisen at his bidding and everywhere experiment and waste have dwindled at his command. Besides the early applications of science with which his name is linked, and the reports upon matters referred to his committee by the National Government during the war, I recall, among a multitude of others in recent years, laborious investigations upon water-gas for illumination and fuel, upon the purification of coal-gas, upon marbleized or granite iron-ware, upon the fitness for industrial purposes of the water supply of towns, and upon the burning of bagasse and other wet fuels. This but hints at the variety of his studies and the range of his association with men of affairs. It is to works like these that we must look for the continuation of the liberal support which even pure science is now receiving from the productive arts.

"To love her," said *The Tattler* of Lady Hastings, "was a liberal education." To have access to Prof. Silliman's study, was to lay the foundations of character. It was to make all lovely things seem still more lovely, to learn the worth of easy circumstances, of domestic peace, of gentle sympathy, of devotion to duty, of learning, manners, and modesty, of simplicity when fortune smiles, of unswerving fortitude when she frowns. His library was a large room, blending by ample bay window with the garden. Its stretch of floor was broken by thick and kindly rugs, by escritoire and reading desk, by map cases, easels, and quaint chairs. Its mantel over-arched a grate of flaming coal which cast a glow like the peaceful love that reigned there. Piled high around were line after line and tier after tier of scientific periodicals and books, most cherished if not sole return from half a century's devotion to the *American Journal*. The sustained and serious, but bright and cheerful, occupation of the family, the earnest but above all kindly face of the master, complete a picture such as we love to hang on memory's wall.

Although the scientific work of Prof. Silliman extended through a round fifty years, the number, variety, and laboriousness of his contributions show how systematic and incessant his labors must have been. What he has accomplished, however, will be appreciated only by those who know how manifold were his interests outside of science, by those who have learned the prodigality with which he bestowed his time upon his pupils, by those who remember his remarkable faithfulness to the humblest duties, even self imposed.

I first sought his aid when interested scientifically and financially in the new water gas manufacture. At once his own library and, through his intercession, the laboratory of the New Haven Gas Company, to which he was consulting chemist, was placed freely at my disposal and he undertook gratuitously the direction of my investigations. In sickness and health, in rain and shine, through a long year his kindly face brightened daily the doorway of that remote and inaccessible room, "just for a little encouragement, you know," as he would say when I insisted that no help would be needed to-morrow. I soon had opportunity to disabuse my mind of any suspicion that this was through partiality for me, for it became evident that all his pupils were made to feel the same privilege of trespassing on his time. Certain attorneys from New York beset him one day to give evidence in a patent case, insisting that the large interests of their client hung upon his testimony. But he answered very firmly that while he had always felt that a scientific man ought to be the servant of the people, especially of their courts, and while he would be very happy to assist in establishing the justice of their client's claims, of which he happened to be in a position to be well assured, he was yet before all things a teacher, that he had a class of six students looking to him for daily direction and advice, and that he could not consent to leave New Haven for a month yet, or until his first business was done. The court held the case open till that class had completed its course in chemistry.

There was another element of Prof. Silliman's character which contributed not a little to his influence over his pupils. From youth he had been a traveler. His work had called him into all portions of the Union, into contact with all classes of society; into the barracks of the mill hands, the cabins of the miners, the salons of the proprietors. He had studied the petroleum of Southern California, the mines of Oregon. He had written for New Orleans the first course of lectures upon agricultural chemistry ever delivered in this country. In a high social position, as representative of an old and honored family in his State, the editor of a journal, in its department, *facile princeps*, one of the original fifty of the National Academy, he had lived on terms of intimacy with the learning and the culture of the land. He had visited abroad with his father, the honored guest of the scientific societies of Europe, and in turn he had entertained at home the most distinguished representatives of learning from England and the continent. His mind, broad by cultivation and sympathetic by nature, had reaped the full benefit of these associations, and with his manners, simple indeed but at all times

easy, he was enabled to enter at once into the thoughts and hearts of his pupils and draw them in turn into his own.

So he lived, modest in demeanor, not flaunting his achievements, choosing good deeds, and pursuing steadily the path of duty. His life, his words, his works, his rewards, were a perpetual inspiration to the scientific spirit, the love of truth for truths' sake, to a zeal for research, to an eagerness to bestow upon the arts the latest results of science, to a faith that the multiplied interests of a community were one and single. Neither luxurious nor penurious in his habits he saved a modest competence and for the rest spent liberally a handsome income, an income derived not from his chosen profession, for from the founding of the Yale scientific school he too often paid his own salary, and many an earnest student can testify how freely his time, and means as well, have been forced upon his pupils. That was the use he loved to make of the dollars he received from the industries to which he had saved fortunes.

Withal, his life knew its sorrows, none deeper, I think, than the calumnies which befell him in connection with the Emma mine. It was in 1869 when the independents who afterwards started the Greely movement were decrying "Grantism" in all its forms, and calling especially for purity in politics, that a suspicious connection with that ill starred English investment was fastened upon General Schenk, our minister at St. James, and he was made the object of the most unlimited abuse. The virulence did not end with him, but Prof. Silliman was included in the scandal, the whole opposition press being free in its insinuations that his favorable report upon the property was unjustified and corrupt. In vain he courted congressional investigation and sought any opportunity for his vindication. It did not come till 1877, when the principal, Trevor W. Park, was sued by the English bond-holders. But by that time the public had lost all interest. General Schenk was no longer an issue in American politics. It was too late to erase from the popular mind the blot on the chemist's good name.

He had hardly emerged into the penumbra of this shadow, when the death of his loved wife again darkened the day. Then came sickness, financial embarrassments, the infirmities of age, thickening to the end. But under all and through all he remained the same genial and faithful worker and guide.

The attacks which embittered the last years of his revered father seem to have been more provoked and easier to have avoided than the cup of gall which was given to the son. He told me once with great feeling how the genial Emeritus arose in a meeting in which the need of men for Kansas and the cause of Free soil had been debated, and said: "It is not men we need for Kansas so much as courage to fight for the right. I will be the first to give a rifle and brace of revolvers to one who will use them in the Free soil cause; who will give another?" and a hundred voices answered "I." He had pulled the trigger of a loaded gun. Throughout the North shot the cry "a rifle for Kansas." The The New Haven colony at Wabaunsee stands to-day a monument to that inspiration. But the sequel was less fruitful of good. At once from strangers and friends, from former hosts and guests, from old pupils and colleagues, there

poured in letters so cutting, so vituperative, and so scurrilous that till his death, at the close of the war, it was found necessary to scan and sift his mail before he read it.

In many respects the son was weaker than his father; in some he was stronger. Living in and for his fellow men, he read eagerly all they said of him. He could not be saved from the bitterness of their censure. And now that he has laid down the burdens he had so nobly borne and rounded out the measure which it was permitted him to fill, let us cherish the more the lessons he has taught us, and keep warm in the hearts of men his perpetual memory.

KANSAS STATE NORMAL, January 20, 1885.

ARCHÆOLOGY.

"DID THE ROMANS COLONIZE AMERICA."

C. W. IRISH, C. E.

A labored article with the above caption appeared in the numbers of the REVIEW for September and November, 1884, Vol. VIII.

It is my purpose to examine the statements of Mr. Moore, the writer of said article, with a view to ascertain how much fact they may contain, and also what may be the value of those statements to the earnest student, who is striving, out of the meagre points in his possession, coupled with traditions and known customs of the present Indian races, to build up a theory which may account for the origin of the Red Man; at least as plausibly as we account for the origin of the White Man. That by patient study of all which we can gather, we may do so, seems probable, but then in my opinion it must be done by a more credible statement of facts and better founded arguments than has Mr. Moore advanced.

In the first place, why should we begin our study into the origin of the Indian by the enquiry of "From what far-off land came he?" It is plain, I think, that if we ignore the fact that the Indian may have begun his existence here, in the land where *we* now dwell, at the very starting point of our enquiry, we commit a serious error. But not so serious as to take up all the old myths of the Gentiles, Jews, Greeks and Romans, and those of all nations of antiquity whose tales of lost tribes and individuals have come down to us through the medium of history; and try to make those old tales, myths, and traditions true by accounting through them for the origin of the Indian races of America.

Another serious error made in such inquiries, is to assume that the Indian has lapsed into barbarism; to assume that away back in time his progenitors were cultured men, highly civilized and enlightened. How foolish the statements to the effect that "The pre-historic ruins reflect not only a high order of art but are

'founded upon pre-existent models known in old civilizations. This art displays 'a mind and hand trained in the schools of science."

How very foolish such expressions are can only be known to those who have had a chance to see such ruins. We know that the science and art of the pre-historic men of America almost wholly consisted in the manufacture of bows, arrows and spears, and implements of the rudest sort made of stone or bone. We know that his building operations in the main went no farther than the construction of rude mounds of earth, and here and there the erection of buildings of the same material, whose crude and rugged forms about as nearly approach the works of art and the buildings erected by men schooled in science, as does the humble ant-hill resemble a Greek or Roman temple.

It appears from all that I personally know of the American Indians, and have gathered from reliable sources, that they are races of men, who from the very beginning of their existence, *as* men, however distant that may be, have made but little progress in refining their pursuits, their habits and manners, or their arts and manufactures. In short, it is but little more than their form and language which distinguishes them from the brutes with which they associate. Nor does it seem that within them are the elements of progress, nor do they appear to have the power to lift themselves out of the brutish life which they have led for ages. For pre-historic implements and arms which we have been able to find, show by a comparison with the arms and implements in the hands of the Indians at the time of the discovery by Columbus, that in whatever time which may have elapsed between the advent of the Indian Adam and Eve, and the time of Columbus, be it much or little, the red man made but little improvement in anything whatever.

But to return to Mr. Moore. He says on page 237, Vol. VIII, of the REVIEW: "We consider first the most universal of the testimonies reflecting the 'Indian's origin. We say universal, for whithersoever the man wandered over 'the continent, he left behind him as a testimonial the shreds of his language. '* * * . The most common, and at the same time the most 'ancient of the Indian appellations have been preserved. They are the river 'names of the continent." Mr. Moore here assumes that each different tribe of Indians, in whatever its language may differ from the other Indian languages in its vicinity, uses in common with all other tribes the same names for the rivers of this country. How very far from the truth this is. For, as is well known, when a dominant tribe destroys or drives out a weaker one, the dominant tribe gives its own names to the streams, hills, vales, and other landmarks conquered from the enemy, taking pains in fact to destroy all that the weaker one had set-up or named. You might just as well expect a Chinaman to intuitively name the Rhone River in German terms on a visit to it, as to expect an Indian to adopt a name in his region coined by some one else. He never does it. Again, on the same page he says: "The Indian names of our rivers belong to a period when 'one common language was known, when one dominant race ruled throughout 'the entire length and breadth of America."

Mr. Moore then proceeds by a most astounding assumption to make it appear that the river names of America, meaning the Indian names of our streams, are derived directly from the most ancient of known tongues, the "Semitic." I will ask how does this statement accord with his other statement, that the prehistoric man was a man schooled in science? The Semitic tongue was prehistoric, and written language greatly preceded in time anything like science or schools of science.

I pass over much that he says about the terms "Aba" and "Na" in which he gathers up everything in the shape of words beginning with the different letters of the alphabet, from A to R, and tries to make it appear that they all come from "Abana." He quotes the two river names Niagara and Missouri, and endeavors to show that they are derived from Abana, meaning in these instances "restless, rapid, rushing current, a stream or a cataract." Pausing for a moment to remark that the African river Niger received its name from the Portugese, a people whose language is derived directly from the Latin, and that Niger is not at all the native name of the river, I shall state without fear of contradiction that the names of both the Missouri and Niagara are not the Indian names of these streams, but were also given to them by those white men who were the first to see them as discoverers, and were the names of the Indian tribe which happened to dwell on the banks of each, respectively, at the time of discovery. I shall give the Indian name of one of these rivers further on. He also pretends to derive the word Mississippi from the Sanscrit, or Dacian, and says that the original word was Messis-apa. Now, Mr. Moore must possess information which no other man possesses on this point, or else he makes an unqualified misstatement, for I have before me a copy (photograph) of the map drawn by Father Hennepin, and dated 1703. His travels in conjunction with La Salle were along this river in the years 1680–3. Now Hennepin spells the Indian name of the river on this map of which I speak, in one place Meschasipi and gives the meaning Grand River, meaning literally, Great, or Big River. In another place on his map, he spells the name Mississipi. On DeLisle's map, dated 1718, it is spelled the same as last above; and lastly, Captain Carver spells it on his map, dated 1766, Mississippi, and these men were the first ones to get the name from the Indians. Any one who has a knowledge of the dialects of the Algonquin Indian languages, knows very well that the termination of the river name in question, viz: si-pi, sip-pi, se-be, (as I have seen it written in more than one instance on old maps and in writings of the past century) is nothing more than attempts to spell the word meaning river in those dialects. In order that it may be seen that I am right in this matter, I here give the different spellings of the Algonquin word meaning river, as pronounced by various bands of that widely spread nation or family of nations, among which the discoverers the Great River traveled on their way to it, and while along it, and from whom they procured the name, given above and from which comes the name we know it by. The Ojibwa of Sault Ste Marie, Se-be (pronounced See-pee). Ojibwa of Grand Traverse Bay, Se-be (pronounced See-bee). Ojibwa of Saginaw, See-bea (pronounced

See-pea. Ojibwa of Michilimackinac, See-bee (pronounced as spelled). Miami, Se-pe-we. Chippewa, Si-pi (pronounced See-pee). Other bands of the Chippewas living north of the Great Lakes pronounce it Nee-pee, the spelling of which, as I have frequently seen it, is Ni-pi.

I have made it clear, I think, that the Indian name of the Mississippi comes to us from the Ojibwa or Chippewa, and that its meaning was or is "Big River." De Soto, on reaching its banks some years before La Salle, found that the Indians in his vicinity called it "Big River," and I know that the Sioux called it in Hennepin's time, and do to-day call it, Wak-pa-ha-ha; Wak-pa meaning river, and ha-ha meaning falls, or literally River of the Falls, for its great feature in their vicinity was the Fall of St. Anthony. I further know that from St. Anthony's Fall to its mouth, the river was known to all the Indians along its banks, as the "Big River," down to its mouth, except perhaps an Illinois band who called it Mis-seek-si-pi, meaning "The Grassy River," or better "The River of the Grassy Plains." Now I would ask of Mr. Moore his authority for his rendering of the word as he has it on page 241, Messi-apa. If it is possible to twist orthography and etymology so as to derive Missis-si-pi from Aba, Aub or Ab, then all we shall need in future research of the kind, is a Latin dictionary and a Sanscrit Bible. What is the use of a knowledge of the exact meaning of the words in any language if we are to do as Mr. Moore has done in his paper? To pick out certain words in an obsolete tongue signifying whatever they may, and then culling over the thousand and one tongues spoken over the world and taking from them all words which have a like sound with our selected standard, and then assume that they also have a like meaning with the words of our standard.

That Mr. Moore has done this in his paper I affirm, nor is he alone in this matter, for many writers have fallen into the same error, but have not been willful in doing so as Mr. Moore seems to be; for when the original word has not the slightest resemblance in its pronounciation to any of his so-called "Terms," he willfully misspells it, so as to make an apparent agreement. Mr. Moore on pages 364–5, Vol. VIII, wades through a large number of names derived from, or given by Spanish explorers to rivers and places in America, to prove that the Latin word *Aqua* was as he says: "Well and thoroughly known and correctly spoken 'by the native peoples of the American continent." Now I challenge him to produce a vocabulary of a native American tongue, in which the Latin word *Aqua* occurs, or any of its forms as spoken by people of Latin origin, and at the same time meaning water. I also challenge him to find a vocabulary of a native American language in which words, if there are any, beginning with Aq, Ag, Ack, Aqu, Agu, or any other forms, having a similarity with the words Aqua, or Agua, in which the said native American words have a meaning expressive of the word water. It is plain that all the names which he quotes, and which have come to us from Spanish geographers, are words of their own invention. The Spaniards, who with their priests, of the time of the American discoveries, were noted for refusing everything native, abhorred the natives, for they were heathens, and refused them a place in their literature. Hence we know less

about native manners, customs and languages in countries of Spanish discovery, and over which they have dominated, than any other. How funny Mr. Moore's meaning as he gives it, of the river name Orinoco, is, when we know that it means in the native language of that region "Crooked River." He makes it "Orien-aqua," or "River that runs towards the sunrise." On page 367 he renders Michilimackinac, first into Mackinaw, from which he makes an easy jump into "Ma aqua-na." It is well known to every school-boy in this northwest that the work Michilimackinac was the name given to a certain island near the Straits of Mackinaw by the Chippewa Indians, and means "Turtle Island." I would ask Mr. Moore where he gets his term Aqua, meaning water, out of the above true meaning?

On page 368 he again refers to the river names Mississippi and Missouri, which I will notice in passing, to say that I have fully disposed of the origin and meaning of the first, and now assert that the last was never the Indian name of the river to which it is now applied, but was given to it by the white men who first traversed the country from its mouth westward, because the powerful tribe of Indians which they found along its valley were known by the name of Messourias, which name, now changed to Missouri, is given to the State and river. The ancient Indian name of the Missouri was Pekitanoni-si-pi, a name given to it near to its mouth, doubtless by the "Illini." Indians. I have not yet ascertained the meaning of the name, but I do know that all the tribes living along this river above Council Bluffs, call it the Big Muddy River. The Sioux call it almost universally Min-ne-sho-sha Tanka, literally water, dirty, big. Where then is the claim of Mr. Moore to rest, that the word Missouri means "the gathering river?" His statement to that effect is the purest nonsense. Equally so his statement, that the word Jehovah in any sense or form occurred in the ancient Choctaw tongue.

Now, the syllable Chuc, which Mr. Moore makes do duty for the expression Great Father, or God, has in its forms of Chi, Che, or Chu, quite a different meaning. For instance, here in Iowa we have a river, the ancient Indian name of which was Chi ca-qua-se-po. Taking his analysis for the meaning of this river name, we have Chic—God, or Father, Jehovah, aqua,—water, and as se-po means river, he would render it God's Water River, and he would go into rhapsodies over his supposed great discovery of the scolastic knowledge of the Latin tongue by the breech-clouted Indian who named this river. Now let us see what the name of this river means in the Indian tongue to which the words belong. It is Algonquin, and in that tongue Chi-ca means a stink or bad, strong smell of any kind, and as applied and modified in this instance it means Skunk, or strong stinking animal, hence the Indian name of this river rendered into English is Skunk River. Now how divine it does appear, and how scholarly the Indian must have been; "schooled in science and the Latin language," to be able to give the stream such a high-sounding title.

The word Chicago is also of Algonquin origin, and in the case of the city of hat name means Onion, which is a strong smelling plant, and was gathered in

great quantities by the ancient aborigines along the Chicago River (Onion River) and over the marshy flats adjacent. Mr. Moore would have us believe that the name means the City of Jehovah! What a drop there is, from his Latin afflatus down to the level of Indian simplicity! On pages 370–1, Vol. VIII, Mr. Moore says: "In some of our northwestern States the term 'Minne' is often found in 'the native Indian names of waters * * * . It is 'evident that some natural fact gave birth to the expression 'Minne.' What was 'this fact? * * * Geology and physiography unfold 'their testimonies. * * * The English pioneer pushes 'into that same northwestern country and everywhere the same natural facts pre-'sent themselves, and they are marked down on our maps simply the red or the 'vermillion, and if we look into the geographical literature of the country, there 'we shall find the Great Red River (of the North), Vermillion Lake, Red Lake, 'etc. Underlying the country are vast deposits of red clay, red sandstone, and 'vermillion earth. Many of the waters there have in consequence the reddish 'tinge. * * * If we open our authorities on language 'we find in our Indian 'Minne' merely the Latin *minio*, which in plain English 'means precisely the red or the red vermillion clay. It would be difficult to find 'verbal testimonies more conclusive than in those Minnesota names. * '* * The legend says that Minne-ton-qua means 'thundering water.' 'The Latin has *tons* for thundering and the 'qua' is but an abbreviation of *aqua*. 'Minne-ha-ha reveals one of the Roman idioms, etc. In analyzing the word 'Minne-h-aha we discover a superfluous h. * * * By 'reference to authorities on the Latin language we find that the letter h is often 'an abbreviation of the word *habeo*—to hold. The word Minnehaha would 'therefore mean river that holds red or vermillion clay. The waters do hold the 'red element for a long distance."

In the above quotations we have Mr. Moore's attempt at derivation of the words Minne Tonka (not Ton-qua as he spells it,) and Minne-ha-ha. It is proper to say that these names come from the Sioux or Dakota Indian tongue. The word which signifies water in that tongue is Min-ne; it in no sense is taken to mean red. The Sioux words meaning red are Sha, or Duta, the last properly signifying scarlet. The word signifying thunder in that language is Wa-kin-yan, also the word signifying big, or great, is Ton-ka.[1] And again the words Min-ne-ha-ha signify waterfalls, ro literally, curling waters, and is always applied to waterfalls. The words Min-ne Ton-ka signify Water Big or Big Water. Here I must say that the lake so named up in Minnesota got its cognomen from Governor Ramsey of that State. Its Indian name (Sioux) was Mde Tan-ka, Lake Big, or Big Lake. There is perhaps no other State in the Union having so much lake area of pure clear water as has Minnesota, and there is not a lake, or pond, large or small, in the State which has a tinge of red in its waters, nor even so

1 The *n* in each of these words has the nasal sound of *n* in bring, and the *h* in the word ha-ha has a rude guttural sound very much like the sound one makes in hawking a fish-bone from the throat.

much as muddy water within its banks, that I can recall; and I have travelled quite extensively in Minnesota, and have noted very particularly its superficial and topographical features. The small stream which gives outlet to the waters of Lake Minne-tonka is the one which gives rise to the Falls of Minne-ha-ha, its waters falling over that cascade, and although there is an underlying bed or stratum of red clay throughout the region of the lake, and creek, and yet it does in no way give a tinge to the waters of the lake nor to its outlet stream.

It is a well attested fact that throughout the region of Dakota Territory and the States of Minnesota, Wisconsin, and Iowa, there are several underlying strata of red clay, and of red sandstones, yet in no instance known to the writer do these red materials tinge the waters red, nor are they reddish in any instance where they approximate the surface of the ground. Now this being true, what becomes of Mr. Moore's statement to the effect that the waters of this region are so tinged as to readily suggest such names as Red Lake, Red River, etc? The Sioux words Minne-ha-ha signify waterfalls, not "water holding red clay." The Sioux words signifying Red Water River are Wak-pa (river), Minne (water), Sha (red); Minne always signifies water in that language. Then how can this word come from, or be derived from the Latin word *minio?* (red). The Sioux word Ton-ka signifies big or great. How then can it be derived from the Latin word *tons* (thundering), and again, if Governor Ramsey invented the name of the lake, using two Indian words which signify Water Big, or Big Water, how, I ask, is Mr. Moore to derive it from the Latin to thunder, thundering, etc.? It is plain, I think, from all that I have discussed of Mr. Moore's paper, that he is entirely wrong in his statements of fact, and in his deductions. He evidently believes that all the Indian languages of the western continent are but dialects of one original mother tongue, a belief very far from the truth. Fortunately for the archæologist, the Indian tongues come to him in their purity, not having that dilution of terms and phrases which characterized the languages of the eastern continent centuries before an attempt to systematically study them was made. I will say here that not only Mr. Moore, but many others, have been greatly misled in attempts to study and to account for the peculiarities of Indian languages, manners, and customs, by the assumption in the outset, that not only the human family, but all spoken languages, have had the same point of origin. Of these students Mr. Moore shoots the widest of the mark. For if he has either willfully or unwittingly made the misstatements and errors in regard to words belonging to the Sioux or Dakota, and the Algonquin languages, as I have pointed out, then we must believe that he has been equally faulty in his investigations into the meaning of all the words which he quotes from the various American Indian tongues in his paper.

I therefore come to the conclusion that as far as Mr. Moore's researches are concerned, we have no reliable proof that any known Indian language has been derived from the Latin, or in fact from any other known tongue of the Eastern Hemisphere, and I further conclude for the same reasons that the Romans *did not* colonize America.

Iowa City, Iowa, February, 1885.

CAVE AND CLIFF DWELLINGS OF ARIZONA.

REV. ISAAC T. GOODNOW.

Nine o'clock in the morning found us at Flag Staff, 344 miles from Albuquerque. By previous arrangement, Major J. C. Minor, land agent of the Atlantic and Pacific Railroad, soon appeared with his fine span of mules and in a rapid drive of twelve miles southeasterly, through woods and dales, soon brought us to Walnut Cañon, the site of the wonderful Cliff dwellings. With hardly any warning we approached it from a nearly level plain. Emerging from the pine woods which surrounded it, we suddenly found ourselves upon the brink of a deep chasm, said by Major Minor to be 1,000 feet deep, and perhaps of the same average width, though quite irregular. The sides consist of ledges of gray limestone, forming on each side of the cañon a succession of huge steps to the bottom, leaving room for a small stream of water. These layers of rock are perhaps from five to fifteen feet thick. Half way down, some of these ledges are overhanging, from six to twelve feet; the base rock having been crumbled or worn away, possibly in part dug out, leaving a space between the upper and lower ledge from six to twelve feet wide and from five to eight feet high. Here we find the cliff dwellings. The roof, floor, and back side of each dwelling is formed by nature, and it only remains for the inhabitant to build the front side and the ends. This was done with stone plastered together with mud, leaving a low doorway to crawl through. In front of the line of dwellings, nearly at the outer edge of the ledge, is a narrow roadway, or foot path, by which each one could reach his residence. These dwellings in some instances we found in two lines, one above the other, and in one case I found a third, but very short line. I made a personal examination of some thirty-five dwellings, some larger and some smaller, according to the space between the rocks. Major Minor estimates the whole number at 400; extending up and down the cañon five miles. Reckoning five persons to a family, it would give a population of 2,000 inhabitants. Near by among the pines we found fragments of pottery, plain and ornamented. The burial place for their dead has not yet been found, though diligently sought for by Major Minor, who some two years since discovered the dwellings; who inhabited them is a matter of conjecture. They must have preceded the present race of Indians who know nothing about them. And the problem is as much of a mystery to them as to us. One thing I have omitted to notice; approaching from the north—the cañon extending east and west—we struck it exactly opposite a high peninsula connected with the north side, half way down the cañon, by a low isthmus. This peninsula forms a partial division between the eastern and western portions of the cañon that come under our immediate inspection, and must command a fine view of both. I was limited in time and did not ascend to the top, though I examined the dwellings below on

its west side. The Major says the top was occupied as a fort. Certainly no finer site could be chosen. Thus ended our first day's work. On the second day, it being decided that the mountain of the cave-dwellers would be too difficult for Mrs. G. to climb, Major Minor very kindly invited Mr. Thomas and his nearest neighbor, Esquire Hicks, to accompany us. Our road led along the railroad track east several miles and then to the northeast up a beautiful valley, interspersed with handsome pines. We passed on our right a detached volcanic mountain with crater still extant, 300 feet across its southern rim, partly worn away. To the left upon a slight knoll in the timber, was a fort evidently to command the southern approach to the caves.

At the distance of eight miles from Flagg Staff, and I guess twelve miles in a northeasterly direction from the cliff-dwellings, we found ourselves at the base of a steep hill 700 feet high. This forms the southern extremity of a range of volcanic foot hills of the San Francisco Mountains. Ascending the hill at an angle of 45°, its face being covered with powdered lava thrown from the caves near the summit, we found it pretty hard work, as each step upward was sure to give way downward! The crust of this mountain was originally in a molten state, which gradually consolidated into a tufaceous rock, tough and hard. To form a dwelling place, a circular hole was made into the ground, probably to the bottom of what would constitute the floor of the principal room, and it was then rounded out into an oval or circular form, from ten to twenty feet in diameter and from five and a half to seven feet in height, leaving a sufficient thickness overhead to make a strong roof. Out of the main room some two or three other rooms extended; serving probably as sleeping or store rooms. In some cases a room was excavated much lower than the large room, probably answering the purpose of a cellar. Generally the dwellings had no connection with each other, but in some cases they had. At the top and southern brow of the hill was a fort with a part of the walls standing, some three feet thick. It extended east and west across the hill some sixty feet, evidently designed to defend the approach from the northern ridge, which is about on the same level. As a general thing these caves were arranged in parallel and semi-circles, commencing at the top of the hill at the south end just below the fort, and extending down the sides of the mountain, the lower circles being the longest. The entrances to the caves in some cases were near the middle and must have been by ladders, in other cases near one side, and might have been by stairs. Around many of the openings were circular walls, evidently constructed to guard against accidents or as a defense against an enemy. In some of these caves, well away from day light, were beds evidently used by bears or wild animals. As part of the time my explorations were by myself and beyond the hearing of my companions, even with a shout, the query did arise, while poking around with a long stick in the low, dark cellars, what would happen should I find Old Bruin at home? What gave special emphasis to such an enquiry was the fact that my only weapon of defense was a stick. After such reflection my stay in dark passages was not prolonged!

One of the largest caves was near the top by the fort and is supposed to have

been occupied by the head chief. It is thought there was originally an underground connection between this and the fort. If so, the passage-way has been filled and obliterated. Evidently rude and unfriendly hands have left the marks of destruction upon these unique dwelling places. The mouths of many have been completely stopped with large stones, others partially so. The conquerors did their best to render this city of the cave-dwellers uninhabitable. Major Minor, the original discoverer, three years since, estimates the number of the caves at 200. A more beautiful prospect as seen from this town site cannot well be found. East, west, north and south, mountain ranges clad with snow 7,300 feet high, intervening valleys, and detached knobs are commingled in a way to produce one of the most delightful landscapes in the world!

By an article in the March number of the KANSAS CITY REVIEW, I see that another village of the cliff-dwellers has been discovered; it is also situated on a volcanic foot-hill of the San Francisco Range, and is some fifteen miles from the cliff-dwellings of Walnut Cañon. It numbers sixty-five dwellings. The entrance to each is by a perpendicular square hole or shaft, extending from the surface to the floor of the main room at one side. Foot holes cut at convenient distances on the sides of the shaft, served as a stairway. A groove fifteen inches wide and eighteen inches deep, extended from the floor of the main room up one side of the shaft to the surface of the hill. Ashes at the bottom of the groove and the blackened sides above marked the fire-place and the chimney of the dwelling. In the cave-dwellings which I visited, the fire was built on one side of the large room and the smoke was left to find its way out of the circular opening wherever it was. We found fine specimens of broken pottery, plain and ornamental, with the metatas, or hand corn-mills, of the inhabitants, but nothing which would give us any insight as to the tools used in excavating the dwellings. On the other hand, in the interesting article referred to, mention is made of stone mauls and axes used in doing the work, with ornamental pottery, corn-mills, bone awls and needles of delicate workmanship, shell and obsidian ornaments, and implements of wood, the uses of which are unknown. Mr. Stevenson found evidences that satisfied him that the inhabitants here held communication with the cliff-dwellers in Walnut Cañon, but does not say what they are.

The preservation of wooden implements in these underground rooms, where they have lain for centuries with other relics undisturbed, demonstrates with marked distinctness the wonderful dry and preservative qualities of the atmosphere of this strange country. People here ought to live one hundred and fifty years.

We were particularly fortunate in our guide. In his antiquarian researches he is indefatigable and remarkably successful. One year since, at the great bend of the Colorado, seventy miles north, he found the ruins of a great city, extending along the banks of the river for ten miles. It was originally buried in sand after the fashion of some Egyptian cities, and afterwards brought to light again by the winds blowing from a different direction. The dwellings are of stone, two stories high, plastered with mud, similar to the cliff-dwellings. Major

Minor was successful in his search for their cemetery and procured specimens of pottery, etc., with all the skeletons, or remains of skeletons, he wished.

Mr. A. M. Sanford called my attention to the existence of a detached mountain of almost pure salt, situated on the Colorado River, 160 miles north of Kingman; ninety-five per cent chloride of sodium, and five per cent alumina. It is transparent like glass and print can be read through a mass a foot thick! The supply is inexhaustible and eventually must become a source of great profit. Mrs. Goodnow has specimens of pottery from the cliff and cave-dwellings and the newly discovered city, which can be seen by any one having a curiosity. While those from the last-named city exhibits most skill, there is a striking resemblance that assures one that the original inhabitants of all these towns were of the same nationality. In their building operations they adapted themselves to the peculiar features of that portion of the country in which they lived. Arizona in truth is a wonderland! We know comparatively little about it. If the little exploration already made, brings to light so many mineralogical, geological and ethnological curiosities and marvels, what may we expect when fully examined and carefully studied by the scientific travelers of the world?—*Manhattan (Kan.) Republic.*

GEOLOGY.

RAMBLES OF A NATURALIST AROUND KANSAS CITY.—III.

WM. H. R. LYKINS.

One day I sat upon an eminence overlooking the vast fertile plains of Kansas. It was a lovely day in October. A mellow, golden haze filled the air, softening the outlines of other hills which rose in the distance like the bold headlands of a sea coast. In the valley below were cozy farm houses embowered in the variegated foliage of fruit trees, and far away as the eye could reach lay yellow fields rich with the ripened fruit of the husbandman's labor. Herds and flocks pastured upon green meadows, and everywhere were men moving about like busy ants intent upon garnering their winter stores.

It was a perfect picture of the peace, prosperity and contentment of man. "It is, indeed, beautiful," said a voice echoing my thoughts, and turning I saw —or thought I saw,—standing beside me an aged man with a long, yellow beard leaning upon a ragged staff, and, like myself, contemplating the lovely landscape. "It is, indeed, beautiful," said he, "but it was not always thus. Listen!" he continued with sudden energy, "listen and I will tell you how it was. Ages upon ages ago I stood upon this spot. It was early morning and a hot mist obscured the view, but I could hear strange animal sounds, roaring, growling, snarl-

ing, hissing, and startling screams as if all the menageries of the world had been turned loose in this place, and, as the mist cleared away I saw a wonderful scene. Before me lay a vast lake, or inland sea, stretching far away to the north, bordered by a rolling country of rich savannahs and tropical forests, watered by many streams and rivulets, all teeming with animal life. Over the broad valleys roamed herds of elephants, the strange-tusked and triple-horned *Dinoceras*, and many other equally wonderful forms. In the forests monstrous beasts, the *Hadrosaurs*, half-bird, half-serpent, moved sluggishly, feeding on the lofty tree-tops. On the waters of the lake great turtles lay like floating islets; on the rocky reefs sea-serpents an hundred feet in length reared their crested heads and hissed at each other in horrid combat. In the shallows waded gigantic toothed birds like *Hesperornis*, while overhead the leathery-winged *Pterodactyls*—veritable flying dragons—fought in mid-air over their prey, uttering those piercing screams I had heard. By the water-side is feeding a herd of the peaceful *Oreodon*—that curious compound of the hog, deer and camel,—when a pair of ferocious *Drepanodon* or saber-toothed tiger dashes upon them, rending and slaying in the very wantonness of their brutal strength and power. Man, if indeed he has yet appeared upon the earth, has fled far from these savage scenes and sought refuge in the recesses of the mountains whose cold, blue peaks glimmered faintly on the western horizon. It was the *Age of Monsters.*

"Another age had passed away when I returned to this place. How changed the scene! One vast sheet of ice covered all the land. Nor bird, nor beast was to be seen; what few animals had survived the cold had fled far southward. The sun hung low in the southern sky, giving forth a pale and sickly light destitute of heat. An awful silence brooded over the scene, broken only by an occasional moaning, creaking sound as if Mother Earth was groaning in agony underneath the great monster that lay upon her breast. It was the *Age of Ice.*

"After another age, again I returned. As at the first time it was early morning and the sun had not risen, but through the gloom I could see advancing across the plain what appeared to be a monstrous serpent, roaring and hissing as it dragged its jointed length along, a single eye blazing in its forehead, shedding forth a baneful light. Surely, thought I, the Age of Monsters has returned again, but what monster is this, more terrible than any I have yet seen, which seems to devour the very earth before it! But as the sun rose and the light increased, I saw before me cultivated fields, happy homes, towns and cities, churches and school houses, and railway trains—even as you see it now. It was the *Age of Man.*"

"Who are you?" I exclaimed in astonishment, turning to look at my companion again, but he had vanished, and I saw only in his place a bunch of the tall wild Sun-flowers, their yellow heads nodding gracefully to the soft southern wind which murmured musically through their leaves. I had been dreaming of the past, the present,—What will the *Future Age* be when this has passed away?

TERTIARY IN HARPER COUNTY, KANSAS.

F. W. CRAGIN.

EDITOR REVIEW:—If you have space for it yet in this issue of the REVIEW, I show like to record the fact that the tertiary in Kansas south of the Arkansas River can at last be definitely asserted to occur as far east as Harper County. A fossil presented to me from that county by Mr. C. D. Moore, and which was found at a depth of fifteen or twenty feet in digging a well, proves to be the large metatarsal of a Tertiary (probably Pliocene) horse. The fossil has been submitted to Prof. Cope, of Philadelphia, who states that it belongs to a type of horse different from any hitherto known, in having the lateral metatarsals (splints) more closely approximated than usual and *extremely unusual.*

I now refer to the Tertiary, also the conglomerate bed resting upon the Dakota sandstone near the east line of Barbour County. It is from this conglomerate and its former continuation eastward that the streams in that vicinity derive their beautiful array of colored quartz pebbles, and which, owing to its position—lower, as regards actual elevation, than are certain Dakota and all the Niobrara formations in Barbour and Comanche Counties—I formerly referred to the Cretaceous.

The pebble and gravel beds (largely white quartz) of Kingman County and southern Reno, are doubtless to be referred to the Tertiary also.

These developments indicate not only the absence of the Benton and Niobrara in Harper County, but also that the Tertiary is, in Harper County, brought down to within an unusually short distance of the Permian, following and immediately overlying the Dakota nearly to its eastern limit.

ASTRONOMY.

SUN AND PLANETS FOR MARCH, 1885.

W. DAWSON, SPICELAND, IND.

The Sun moves eastward about two hours, or 30°, every month. On March 1st its R. A. will be 22h. 51m.; declination 7° 19′ S. And on the 19th it completes the whole round of 24h., or 360°; passing the Vernal Equinox about 7:00 P. M., Kansas City time, that day. It also crosses the Ecliptic to the north, and by noon, March 31st, has a northern declination of 4° 25′, and R. A. oh. 41m. March is often called a Spring month but, astronomically, Spring season

does not begin till the Sun reaches the Vernal Equinox. Spots on the Sun are larger and more numerous in February, to date (17th), than in January.

There will be an eclipse of the Sun March 16th, visible here as a partial eclipse; beginning soon after 10:00 A. M., and ending near 1:00 P. M. The Moon will be so far from the Earth that it will appear smaller than the Sun, and the eclipse will be annular, i. e. where it is central the outer edge of the Sun will be visible like a bright ring around the black Moon.

The path of central eclipse will strike the United States about 150 miles north to northwest of San Francisco; pass northeasterly into British America; cross Hudson's Bay and Greenland; leaving the Earth near 200 miles north of Iceland. There will also be an eclipse of the Moon, March 30th, about 10:00 A. M., and, of course, not visible here. But it may be seen on the opposite side of the Earth, nearly from Pole to Pole. For table of eclipses see REVIEW for August, 1883.

Jupiter and Saturn are now grand objects for evening observation. Saturn crosses the meridian soon after 6:00 P. M. in the early part of the month, and is inconveniently high for observation till 8:00 or 9:00, when it will have descended to a good position. The ring will continue at its widest phase with little variation for several months. Jupiter is a diamond beauty in the eastern sky; rising on the 1st, at 4:44 P. M. and southing about 11:30. Mercury is in conjunction March 13th, and will hardly be visible during the month. Mars is just passing conjunction, and will not be visible for some time. Venus is still a Morning Star near the horizon. It is declining northward and crosses the equinoctial March 31st, when it rises exactly east, half an hour before sunrise. Uranus comes to opposition on the 21st, when its R. A. is 12h. 5m., and declination 0° 21′ N.; being very near Eta, Virginus, and still nearer a small fixed star to the southwest. Neptune is still about where it has been for several months, a few degrees southwest of Pleiades.

THE ECLIPSE OF THE SUN OF MARCH, 16TH

PROF. W. W. ALEXANDER.

On March 16th, 1885, there will be an annular eclipse of the Sun, visible at Kansas City as a partial eclipse. The elements are as follows, by "Central Standard Time":

Conjunction in Right Ascension 12h. 14m. 23.6s.
Sun and Moon's Right Ascension 23h. 46m. 35.35s.
Sun's hourly motion 9.13s.; Moon's, 126.07s.
Sun's declination 1° 27′ 12.0″ South.
Moon's declination 0° 39′ 11.0″ South.
Sun's parallax 8.9″; Moon's, 57′ 7.7″.

From these elements may be deduced the following results: Central eclipse begins at sunrise, in the Pacific Ocean, about one thousand miles west of San Francisco; from this point it will sweep in a northeasterly direction; leaving the ocean it will enter the United States in Latitude 40° North, and cross the northern part of California and Nevada, passing over the great Salt Lake of Utah, and through the center of Wyoming and Dakota Territories. It will encounter British America and pass over Lake Winnepeg. Hudson's Bay, and Greenland, and continuing on in the same line, it leaves the Earth at sunset in the Atlantic Ocean about four hundred miles east of Greenland.

As seen from Kansas City the Moon will pass too far north to cover the Sun; so we will get only a partial eclipse, the northern limb and a little over half of his diameter being covered at the time of central eclipse, 11h. 55m. A. M.

The time of first contact or beginning of the eclipse here will be 10h. 30m. A. M., and on the northwest edge of the Sun is where it will first appear. Last contact, or end, will be at 1h. 20m. P. M., and on the northeast edge of the Sun.

In eclipses of the Sun we see no visible effects of umbra and penumbra on the Sun itself. We have the real (though invisible) Moon eating into the real and visible Sun, and along the line named above, there would have been a total covering or hiding of the Sun by the Moon, if its apparent size had not happened to be less than that of the Sun at the time of central eclipse.

To explain this I must give a few figures. As both Sun and Moon are round, or nearly so, the shadow from the latter ends in a point. The shape of the shadow, is in fact, that of a cone, hence the term "cone of shadow." Now, the length of this cone varies with the Moon's distance from the Sun. When nearest, the Moon will of course throw the shortest shadow. The lengths are as follows: when the Sun and Moon are nearest together 230,000 miles, when farthest apart 238,000 miles. The distance from the Earth to the Moon also varies as follows: when nearest together 225,900 miles, when farthest apart 251,000 miles. Hence, when the Moon is farthest from the Earth, or in apogee, the shadow thrown by the Moon is not long enough to reach to the Earth. At such times the Moon looks smaller than the Sun, and if she be at node we shall have an annular eclipse—that is, there will be a ring (*annulus*, Lat., ring) of the Sun visible around the Moon when the eclipse would otherwise have been total.

The most simple way to protect the eyes in watching an eclipse is to use a plain piece of glass smoked over a coal-oil lamp until it is sufficiently dark to obscure the glare of the Sun.

EDUCATION.

DIFFICULTIES IN SEARCHING FOR TRUTH.

PROF. S. H. TROWBRIDGE.

There is no end of theories upon all questions now vexing the public mind, —whether scientific, theological, social, political, or what not,—and he who cannot find among this maze of wisdom and unwisdom, plausibility and absurdity, a a doctrine to please him must be very hard to suit. The chief trouble is, the majority are pleased with too many of them. No mountebank can proclaim views so wild and absurd as to be without followers. Most men allow others to think for them. They simply absorb like a sponge, and, like it, as readily give up what they have taken in when squeezed a little by the next theorist. The "people" who "do not consider," and who "are destroyed for lack of knowledge," are as universal as the human race, and the persistence of this trait has not less weight than some others urged in proving that the race is one. They who live "to tell or to hear some new thing" are not dead yet, and do not all live in Athens.

But a doctrine is not to be condemned because it is new, or to receive unquestioning acceptance because it is old. The Ptolemaic system of astronomy was fully believed in for a score of centuries, and afterwards found to be fallacious; and we know not how many accepted theories of the present day will be swept away with the advancing floods of intellectual progress. The question of a true philosopher is not whether the doctrine is musty and discolored with age, or is young and untried as the new-born babe; but whether *it is true*.

A most important desideratum to an investigator is a disposition to see both and all sides of a question with equal candor. An unbiased mind, which searches *alone* for *truth*, is the only one qualified to investigate with success or safety. If one begins with preconceived opinions, he is almost sure to become a special pleader in favor of the notions he most desires to establish. With a theory to prove, especially if he has expressed it with any considerable positiveness, he must have virtue almost super-human to give equal weight to arguments for and against it. Men are naturally so averse to any intimation that *they* have ever made a mistake, or failed to see through and through a thing at first sight, that a change of views is, to many, a confession of weakness or ignorance. Owing to this prevailing weakness of human nature,—which is a far more serious malady than the fallibility it is designed to conceal,—it is extremely wise to withhold any positive expression of opinion upon a debatable or much debated question upon which one wishes to reach the highest truth. Of course, one must have a work-

ing *hypothesis*, and some theories to *test;* but this is far different from having a position to *maintain* at all hazards.

Another serious obstacle to the search for truth is that men are too apt to accept the "confident assertions and well-put arguments" of popular writers and speakers without inquiry, when these accord with the views they wish to believe. The merest charlatan has only to say his opinions are based upon those of some "distinguished investigator,"—whose name he is very careful not to mention,—to give his assertions the full weight, in the minds of many, of a naturalist or statesman, a theologian or philosopher, who has exhausted his subject in original and painstaking research. We have ample illustration of this sort of special pleading and of the suicidal popular craving for it, (without mentioning numerous others) in the criminal distortions of the teachings of both nature and Scripture in the interests of infidelity, and the hardly less criminal ignorance of these things in the interest of religion. It is sadly humiliating to see those whose professions would argue clearer discrimination, grasping at untenable theories because they are fancied to establish notions one wishes to maintain, or positions supposed to be essential. This state of things is largely due to the popular willingness to be imposed upon and the vicious cramming system of ordinary school instruction; both tending to the destruction of independent thought.

While this practice of running wildly after every new theory is pernicious in its effects upon the legitimate investigations of our times, the fact that great changes in sentiment and practice are yet to be looked for should not be ignored. There are, doubtless, phenomena continually exhibited all about us which we do not even perceive, much less understand, but which it is the office of independent thought to discover, investigate, and explain. That revolutions are yet to take place, the rotten foundations of our present political fabrics but too clearly indicate. Bickerings and jealousies in the church show that it must have yet other reformations. And the arbitrary laws of popular custom need to be completely revolutionized. Lack of the habit of observation, tenacious adhesion to party and precedent, selfishness, and fear of violating the exactions of society, are the obstacles here. Undue conservatism tends no less to lock the wheels of intellectual progress than excessive fanaticism.

The bull-dog method of convincing an audience or an individual is another fruitful source of evil. There are intellectual highwaymen who *assert* with such positiveness their unsubstantiated tenets,—as if annihilation, total and immediate, would be the price of non-acceptance,—that ordinary minds tacitly assent, on the principle that discretion is the better part of valor. They are simply overpowered, not convinced. When one in the form and fashion of a man, with commanding impudence thunders out, either in word or in substance, "you are wrong, sir, and I am right, and you are a fool if you don't admit it," I yield to him as I would a bandit with a loaded pistol at my head, and with very much the same feeling toward him. He has by brute force suppressed all expression of opinion from any who would not be as ill-mannered as himself; but has not forced from a thinking hearer the reserved right to hold views sustained by the

latter's own reason and judgment. Too many are, by these intellectual mastiffs, completely frightened out of all future claim of right to their own opinion, on the very erroneous supposition that what is so positively asserted must be true. On the contrary, the more carefully and honestly one has examined all phases of a much-disputed question, the more of truth does he see on both sides, and the more hesitancy he feels in positively pronouncing his convictions: whereas, he who has seen only one side is thoroughly convinced (like the negro judge, who could decide best before the arguments for the defense had confused him) that the case is so clear already that further argument is superfluous. So true is this that, perhaps, no better rule can be given for estimating the value of an author's statements on mooted topics than this: the weight of his opinion is in inverse ratio to the positiveness with which he asserts it.

The field in which a single individual can be an absolutely *original* investigator, is a very narrow one. No *one* can examine *all* the facts bearing upon any important subject of discussion. All are, therefore, compelled to take on trust, to a greater or less extent, the observations and often the interpretations of others. With the severest scrutiny and most scrupulous care, this is often hazardous and misleading. No two persons see exactly alike, even when both have sight and judgment in normal condition. Each observer sees a different rainbow, and even the two eyes of the same observer, as in a stereoscopic view, see different phases of the same object. Such physical defects as near-sightedness or color-blindness of which often the individual himself is not aware, may materially modify the appearance of things he has carefully examined. Moreover, one's powers of discrimination are liable, often unconsciously, to be warped by personal interest or by prevailing opinions and habits of thought, and, through ignorance of this fact, far too high an estimate may be placed upon the results attained by him. Again, with perfectly normal vision, and totally free from mental bias in any direction, one may fall far short of the soundest conclusions through *lack of training* in observation, comparison, and judgment. The conclusions of a novice should not be graded with those of a trained investigator. He may be possessed of equal powers by nature, but has not learned to use them with equal discrimination and effect. Nor does it follow, because one is an adept in a single line of effort, that he is equally trustworthy in every or in *any* other. The old truth, taught by Æsop, that nature does not confer every good upon one, is too often forgotten. An authority in theology, for instance, is not necessarily an expert in science or philosophy. That he is necessarily *not* an expert in these would, doubtless, from the nature of the case, be equally true. So, high official position, or even eminent success in certain directions, often carries with it, in the judgment of the masses, an authority far above its real value. Advancement in position or circumstances may be due to brass, selfishness, favoritism, or accident, and not to real worth.

These considerations and many others are too often overlooked or ignored in reaching conclusions. To weigh correctly the stated results of every investigator, it is necessary to have his personal equation, or error, as carefully deter-

mined and as clearly expressed as that of an astronomical observer; and to have all the helps and hindrances to his work, tending to modify his results, estimated with the same vigorous discrimination. Except, perhaps, in the line of mathematics, we have no *means* of doing this, because we have no fixed standard of comparison as in the heavenly bodies and in the direct proofs possible to mathematical reasoning. In other lines, the nearest to accuracy we can reach is in the careful balancing of probabilities. In this, too, the personal liabilities to error are involved, and thus the conclusions of erring men, even with equal honesty and candor, are necessarily subject to infinite variation.

Another difficulty in arriving at truth, growing out of our necessary dependence for data upon the researches and statements of others, is in the liability to miscomprehend the facts as stated. If an author's statements are written, by the simple oversight of a comma his words may convey a widely different meaning from that he intended. The mistake of a little girl who protested that there would be plenty of preserves to eat in heaven, because the catechism says, "He makes, preserves, and keeps them;" and the pessimist's quotation, "There is a divinity that shapes our ends rough, hew them how we will;" are not without a parallel in many a more profound research. When statements are taken from oral delivery, it is easy to fall into an error like that of the little girl who, on returning from Sunday School, asked her mother what kind of a bear a consecrated cross-eyed bear was. She had heard them sing, "The Consecrated Cross I'll Bear." Another, who had heard repeated the golden text: "Behold! a greater than Solomon is here," said on returning home that the text was, "Hold a grater to Solomon's ear." Men are often charged with statements which are equally foreign to their real sentiments. This may be due to no lack of honesty but to lack of good hearing or of discrimination.

In too many other cases, however, it is nothing but sheer dishonesty. Even men in high positions are not infrequently detected in garbling quotations from more original authorities, coloring their extracts to favor their own views and positions, when the real meaning of the author quoted is entirely different. Lorenzo Dow's text from the Bible, "Top-not come down," (Matt. 24, 17), for a sermon against the coal-hod bonnets of his day; the wag's rendition of Scripture, "The wicked flea, when no man pursueth but the righteous, is as bold as a lion," are not a whit further from the truth intended than many of these mutilated quotations.

It is not particularly assuring to one who wishes to keep a general run of the best thought and work of the age, and must take it largely at second-hand, to be engulfed in such a chaos of deception and contradiction as the following, which is not an imaginary case: One reads an article by a not unknown writer, setting forth views pleasing to the reader and such as he would gladly accept. He notes them as of peculiar interest. Coming to "editorial notes" in the same issue, he finds expressions of doubt as to their correctness. In a latter issue the reader is reassured by a rejoinder in which the criticised author maintains his position "without fear of successful contradiction" by a long array of instances, and fortifies it with copious quotations from the writings of known and trusted

investigators in that special field, and names many others who accept his conclusions "with very slight, if any, qualification." The disappointment of the student is bitter when, on further reading he finds that two independent critics almost annihilate an authority upon which the first author had most largely depended for support in his position. This authority had inserted and omitted words in a direct quotation from a still earlier author which gave the latter's words an opposite meaning; and had given great weight to the views of another, himself "known to be very unreliable as an authority." In another publication, the student finds the original defendant further discomfited, and his own confusion increased, by reading that the paper of the defendant's main authority, while dubbed "very able" and "forcible" by one reviewer, is said by another to be "remarkable for its erroneous statements and its misapprehension of facts," and "still more remarkable when we consider its assumptions for what it does not contain." Still another authority, quoted by both the defendant and his right-hand man as of great weight, was shown by yet another critic to have retracted the very statement quoted and confessed he was misinformed. In view of the inherent difficulties in the way of a satisfactory solution of the many deep questions which vex the thinking world, it is immensely important that these difficulties be not wantonly multiplied by parties who warp truth and insinuate error in dishonest attempts to establish their own positions.

GLASGOW, MO., February, 1885.

BOOK NOTICES.

ORIGINAL RESEARCHES IN MINERALOGY AND CHEMISTRY: By J. Lawrence Smith, M. D. Octavo, pp. 630. Edited by J. B. Marvin, B. S., M. D., Louisville, Ky., 1884.

This handsome volume, as stated in the February number of the REVIEW, was prepared at the request of Mrs. Smith as a testimonial of her esteem and as a memorial book for presentation to Professor Smith's scientific friends and relatives. Dr. Marvin has devoted much well spent time to its preparation, and the publishers have put it forth in elegant and substantial form.

Professor Smith was essentially an original investigator, and, from his student days to the end of his life, labored earnestly and diligently as a skilled explorer in the several fields of chemistry, mineralogy and physiology. He had hosts of friends among the learned scientists of this country and Europe, and received honors from nearly all of the scientific associations on both sides of the Atlantic. Besides the biographical sketch of his life by Dr. Marvin, prepared by request for the American Academy of Arts and Sciences of Boston, another was written for Year Book of the City of Charleston, S. C., by Middleton Michel, M. D., and

still a third for the National Academy of Sciences by the late Professor B. Silliman. In fact, one of the last literary labors of Professor Silliman was the preparation of this memoir to his old friend and colleague, and almost his last energies were given to directing the completion of the medal which is, through the liberality of Mrs. Smith, his devoted widow, to be presented to discoverers in the study of meteoric bodies as the "J. Lawrence Smith Medal."

Beginning life as a civil engineer, he devoted himself earnestly to acquiring a complete knowledge of his profession, but finding it not altogether to his taste he abandoned it and studied medicine, giving six years to it in the best schools of this country and Europe. Returning home at the age of twenty-six, he commenced lecturing in the medical college at Charleston. From that time forth he was a teacher; a portion of the time in the University of Virginia and afterwards in the University of Louisville. He was appointed at the age of twenty-eight, at the request of the Sultan of Turkey, to teach the agriculturalists of that country in cotton culture, and was subsequently made a government mining engineer by the Sultan, in which position he was so serviceable to that country that he was honored with numerous decorations and costly presents.

His researches in chemistry and mineralogy were published from time to time in *Silliman's Journal*, the *American Chemist*, *Cosmos*, the Proceedings of the American Association, etc., as well as in several of the principal French and German scientific periodicals of the day, and were regarded as valuable contributions to knowledge. His collection of meteorites is one of the most extensive in the world, and he was an acknowledged authority on this subject.

His original researches number about one hundred and fifty, while his lectures, addresses, scientific and secular papers amount to many more than this. Aside from his professional labors of all kinds, his life abounded in beneficent acts, and he was able to say at its close, "Life has been very sweet to me. It comforts me. How I pity those to whom memory brings no pleasure."

GEOLOGICAL EXCURSIONS, OR THE RUDIMENTS OF GEOLOGY FOR YOUNG LEARNERS: Alexander Winchell, LL. D. 12mo., pp. 234. Illustrated. S. C. Griggs & Co., Chicago, 1884. For sale by M. H. Dickinson, $1.50.

Of all of Dr. Winchell's works this simple book for children is likely to accomplish the most good, from the fact that it begins at the right place,—in virgin soil—so to speak; where there is nothing to be unlearned and where the good seed will take firm root and bring forth good fruit. The teaching of geology is usually postponed until "college days" and there the whole science is crowded into a few months at the rate of about two lectures a week and—at least in our own case—without specimens or practical field illustration. Every man remembers his youthful collections of "petrified wasps' nests," "funny stones," etc., and how easy it would have been to have crystallized his enthusiastic interest and admiration into actual practical knowledge at that time, whereas in most

instances he knows as little now as then of geology, notwithstanding his subsequent "course" in college.

Dr. Winchell, in this text-book takes the pupil in this impressible stage of life and by means of illustrations from the garden, the field, the gravel bank, the laboratory, in the marble yard, by the water side, in the gorge, at the rocky ledge, etc., familiarizes even the youngest pupil with the various kinds of rocks, gravels, and clays of, which the crust of the earth is formed. He then takes excursions to the White Mountains to examine the Eozoic rocks; to the Upper Mississippi to examine the Cambrian formation; to Niagara Falls to learn the history of the Silurian; to Mackinac for the Devonian; to Burlington, Iowa, for the Lower Carboniferous; to Selma, Alabama, for the Mesozoic rocks; to Claiborne, Alabama, for the Tertiary formations, to the river valleys for the Quartenary; to Switzerland for Glaciers, and finally, through the Ages for a comprehensive history of the plants and animals of the past.

Much use is also made of maps in training the learner, objectively, to proper conceptions of superposition, succession, continuity and other phenomena of the stratified rocks.

At the end of each chapter "Exercises," consisting of questions upon the previous statements and subjects growing out of them, are found, which is an admirable feature of the work, since it tends to keep the pupil thinking for himself and not permitting him to depend solely upon his text-book.

As a text-book for beginners in the study of Geology—and they cannot begin much too early—this is the best work we have ever seen, and the advantage of it is that any teacher can teach it without previous knowledge of the subject.

CONDITIONS OF MENTAL DEVELOPMENT, AND OTHER ESSAYS: By Wm. Kingdom Clifford, F.R.S. Price 15 cents, post-free. J. Fitzgerald, New York, 1885.

This volume forms No. 65 of the *Library of Popular Science.* Besides the essay on Mental Development, it contains three other essays by the same distinguished author, namely, "The Aims and Instruments of Scientific Thought;" "Atoms;" and "The First and Last Catastrophe." Prof. Clifford stood in the foremost rank of scientific philosophers, and the essays here published are among his most elaborate productions. They are now for the first time offered at such a price as to bring them within the reach of all.

SCHOOL KEEPING. HOW TO DO IT: By Hiram Orcutt, LL. D. 16mo., pp. 248. New England Publishing Co., Boston, 1885. For sale by M. H. Dickinson; Cloth $1.00.

The design of Dr. Orcutt in publishing this work is to aid and encourage those who need and would profit by the experience of others and to awaken an interest among other classes as well as teachers in the subjects treated.

It is divided into seven chapters: "Theory and Practice," in which the theory is reduced to practice; "How to Begin" with patrons and pupils; "How to Govern" one's self as well as one's pupils; "How to Teach," "Physical Culture," with a supplemental manual of gymnastics; "Morals and Manners," "Temperance in Schools," with a treatise upon Physiology and Hygiene.

The work is practically a rehearsal of many of the scenes and much of the work of the author's school life, and is a result of his long experience and observation as a teacher. It should be extensively read by teachers and those interested in the subject of teaching.

SYSTEMATIC MINERAL RECORD: Edward M. Shepard, A. M. Octavo, pp. 98. A. S. Barnes & Co., N. Y., 1884. For sale by M. H. Dickinson.

This little book has been published by Professor Shepard, after four years use of it in his classes at Drury College, as a means of training the student to habits of observation and correct methods of reasoning in the department of determinative mineralogy. It consists of blank forms for the description of any given mineral, with all of its physical and optical characteristics, and also for its chemical properties. On the reverse side of each of these blank forms are spaces for noting its associated minerals and any other points of interest connected with it.

Preceding these schedules are some twenty pages of explanatory text, defining minerals and explaining their physical properties and chemical characters, with their peculiar characteristics under each of these heads, such as touch, specific gravity, structure, hardness, cleavage, magnetism, odor, taste, solubility, assaying tests, as fusibility, color-flame, etc.

All the terms and chemical reactions used in describing minerals are given and explained, also lists of chemicals and apparatus most needed in blow-pipe analyses, with the names of minerals suggested as a foundation for a term's work in mineralogy with laboratory practice, and a full list of the most important works on mineralogy with prices, when known.

It is probably the most complete work of the kind in print and will be found exceedingly useful to both professors and students.

RURAL TASTE By G. M. Kern. Octavo, pp. 141. Herald Printing House, Columbia, Mo., 1884. For sale by M. H. Dickinson; 75c.

The object of the author is to explain the principles of the art of landscape gardening and the cultivation of rural taste in western towns and country districts. Mr. Kern is a practical landscape gardener of long experience, thoroughly educated, and an artist in his line. He has had charge of the leading parks of St. Louis, and his effort in this book is to make such work a branch of education. Professor Fleet, of the State University, endorses him and his objects in the

most flattering terms, and commends this book to the teachers of the country as worthy of their adoption as a text-book in their schools.

It is divided into three parts, viz: Matters of Taste, under which head he treats of principles of art, principles of taste, floral taste, etc. Secondly, Matters of Art, such as the art of design, ornamental gardening as an art of design, the study of nature, first principles of association, study in landscape gardening, etc. Thirdly, Matters of Fact, under which he discusses correct judgment, home gounds, public improvements, grounds of institutions of education, and the burying ground.

The work is written in graceful style and the subject is presented logically and impressively. No one can read it without being convinced that Mr. Kern is master of the subject and that his thoughts are worthy of careful attention and general adoption.

OTHER PUBLICATIONS RECEIVED.

Meteorology of the Mountains and Plains of North America, an address before the Cattle-Growers' Convention at St. Louis, by Silas Bent, St. Louis, Mo.; E. P. Studley & Co., printers. *Annals of Mathematics*, edited by Ormond Stone and Wm. M. Thornton, Office of publication University of Virginia, Vol. I, No. 4, Charlottesville, Va. Trumbull, Reynolds & Allen's Annual for 1885, Kansas City, Mo. *Journal of New York Microscopical Society*, edited by Benjamin Braman, Vol. I, No. 1, New York; $1.00 per year. *Journal of Mycology*, edited by W. A. Kellerman, Ph.D., and assisted by J. B. Ellis and B. M. Everhart, Manhattan, Kansas, January, 1885, Vol. I, No. 1; $1.00 per year, 15c. a number. Supplemental report of the Railroad Commission of Tennessee, by John H. Savage, Nashville, Tenn., Albert B. Tavel, printer. *The Iowa Historical Record*, published by State Historical Society at Iowa City, January, 1885, Vol. I, No. 1. Water Purification for Steam Boilers and Laundry Purposes, William Tweeddale, Topeka, Kansas. *The Canadian Science Monthly*, No 1, Vol. III, Wolfville, N. S. *The Humboldt Library*, No. 65, price 15c.; Conditions of Mental Development and other essays, by Wm. K. Clifford, J. Fitzgerald, Publisher, N. Y. United States Consular Reports: Labor in Europe, Letter from the Secretary of State; Washington Government Printing Office, 1885. Circulars of Information of the Bureau of Education, No. 7, 1885: Aims and Methods of the Teaching of Physics, by Professor Charles K. Mead, Washington, D. C. Prix-Courant, d' une Choix de Graines, spicialement recommandables pour, 1885, Monsieur le Director La Compagnie Continentale d' Horticulture Gand (Belgique). Columbus, Ohio: Its Commerce, Industries and Resources of 1885, published by the Columbus Board of Trade. Early Migrations, Arctic Shifts and Ocean Currents, by Charles Wolcott Brooks, San Francisco, California, 1884. *The Auk*, Vol. II, No. 1, January, 1885, Boston, Mass., Estes & Laureat; $3.00 a year, 75c. a number; edited by J. A. Allen, Cambridge, Mass. Department of Interior,

Building for the Children in the South, Washington Government Printing Office. Report for the year 1883-4, presented by Board of Managers of Observatory to the President and Fellows of Yale College.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

PRODUCTION OF INODOROUS COAL OIL.—This process especially contemplates the treatment of refined oil, the object being to thoroughly remove all traces of the original odor from the kerosene.

To this end the invention consists in employing induced currents of air as a vehicle for carrying away a portion of the odorous impurities in the liquid, and of neutralizing or destroying a further portion of such impurities by the action of sulphuric ether, and while changing the color of the product, in neutralizing the remaining impurities by the addition of a coloring compound and a mixture for imparting fragrance.

In the procedure of carrying out the invention the kerosene is located in a suitable tank where it is acted upon and thoroughly agitated for the period of four hours, or thereabouts, by currents of ordinary atmosphere induced by any suitable air-pumping apparatus connected to the said tank.

When a certain quantity of sulphuric ether (about one drachm to each gallon) is added to the product while in the tank, and thoroughly incorporated therewith by the action of the air-currents which are again supplied as before stated and continued for the period of about ten minutes.

The color of the product so formed may now be manipulated to any desired shade by adding to each fifty gallons a mixture consisting of one ounce of aniline (any color) and twelve ounces of linseed oil.

The addition of this coloring mixture not only changes the color of the product but a portion of the remaining impurities are neutralized thereby.

To still further and completely destroy any remaining trace of odorous impurity that may adhere to the product, and, at the same time to impart a pleasing fragrance thereto, a mixture consisting of one ounce of oil of almonds (or any other fragrant extract oil,) and one ounce of sulphuric ether is added to each fifty gallons of product.

The above described process has been patented by Mr. Leon Blumenthal, of Kansas City.

IMPROVED TUBULAR WELL.—The object of this invention is to provide tube-

wells with such improved water-lifting devices as will render their construction and repair more certain of accomplishment, and their operation comparatively more reliable than heretofore.

It has been found in practice that, owing to the nature of the ground through which the greater number of tube wells are bored, the cylinder corrodes so as to be within a short time almost or entirely unfit for service.

In order to remedy this defect it is proposed to galvanize the cylinder both internally and upon its outer surface.

Heretofore much difficulty was had in driving check-valves to their seat at the lower extremity of the cylinder or driving-barrel. As there was practically nothing connected to them that would keep them in a vertical line with the cylinder, they would, as it were, attempt to turn end for end, and in many cases would come to and be left upon their bearing in an oblique position.

A check-valve under such circumstances could not fully accomplish the object which its name implies. An improved check-tube is closely encircled near its lower end by a turned ring which has a diameter corresponding to the bore of cylinder.

When the check-tube is being driven to place the drill-rod is attached to its upper end and a rubber packing-ring having a plain outer surface, guides the upper end, and the turned ring holds the lower end in a central position.

The said packing-ring has a flaring internal surface, and it is expanded by a correspondingly tapered cone upon the check-tube. Each of these parts is constructed with smooth surfaces for reasons explained further on.

The check-tube can only be driven downwardly until the coned surface comes in contact with a beveled seat flared from the internal diameter of the turned ring at its upper edge.

Heretofore, owing to the absence of such a seat to limit its movement, the check-tube has been driven so far within the packing-ring that the latter would interfere with the perfect working of the valve, and the packing-ring (usually rectangular in cross-section) would be compressed until when required its removal would be very difficult if not impossible.

The smooth surfaces of the improved cone and the comparatively small body of rubber forming the packing-ring render the withdrawal of the check-tube quite an easy matter. When the check-tube has been fully driven to place, the lower edge of the packing-ring is in contact with the upper edge of the turned ring.

An internally threaded thimble is attached to the lower extremity of the check-tube and prevents the same from being drawn upwardly without carrying with it the turned ring. This latter is secured internally at its lower end forming a concentric shoulder which is engaged by the upper edge of the thimble.

The lower edge of the turned ring or follower rests upon the top edge of the sand-point coupling. This coupling has an external diameter corresponding to the cylinder.bore and its lower edge rests upon a concentric shoulder projecting

within the driving-shoe, and the upper end of the said point is attached to the sand-point coupling, as shown.

Mr. F. H. Smith, of this city, is the inventor.

COMBINED CARPET-MOULDING AND FASTENER.—Mr. Isaac Holzmark, of Kansas City, has produced a new design for ornamental carpet-mouldings of which the following is a brief description. Heretofore fastenings for carpets that were in the form of mouldings, or strips, have been constructed without regard to ornamental outlines—that is, the edge of the strips were in most cases undisturbed, straight lines.

The principal feature of the design is a series of ornamental wings projecting from one side of the moulding and terminating with apexial extremities. Circular spaces separate the said projecting wings from each other, and triangular apertures upon a direct line with the edge of the strip and at a uniform distance therefrom form a part of the wings and impart to them a comparatively artistic and finished form.

The moulding is provided with teeth or claws upon its under surface, for engaging the carpet, and thumb-screws that are easily operated secure the moulding to the floor.

KANSAS CANE AND SUGAR ASSOCIATION.

PROF. E. H. S. BAILEY, KANSAS UNIVERSITY.

At the annual meeting of this Association, held in Topeka on February 5th, a committee was appointed to urge the passage of the bill now pending before the Legislature to foster the sorghum cane industry by the payment of one and one-half cents per pound upon all sugars above a certain grade made in the State. Mr. E. B. Cowgill, U. S. Commissioner for the sugar industry in Kansas, gave an encouraging account of his experiments on keeping canes in Silo. The canes were laid in windrows and covered with about six feet of soil. Analysis frequently made showed that the proportion of sucrose diminished but slightly, while that of glucose increased. There is great hope entertained that by thus keeping the canes the working season at the factories may be doubled. A method of evaporation by hot air was discussed in a paper by Mr. A. A. Denton. Prof. Failyer urged the necessity of greater economy in methods of extracting the juice. By present methods only about three-fifths of the available sugar is obtained. It is possible that in the diffusion process lies the solution of this problem. The sugar content of the cane may probably be largely increased by careful and judicious cultivation. Mr. Bennyworth proposed that the canes be steamed before going through the second pair of rolls. As far as his experiments had progressed this process was a great improvement. Mr. Parkinson suggested that as the seed of the sorghum contained so much starch all manufacturers should

utilize it as a source of glucose. Prof. Bailey read a paper upon the relative values of different sugars. From his experiments glucose has six-tenths the sweetening power of cane sugar. Prof. Scoville discussed the early history of the beet sugar industry, and drew important lessons of encouragement for Kansas cane growers. Prof. Swenson, also a superintendent of sugar works in the State, reviewed the reverses and successes of the business, and predicted that it would prove eventually a financial success. Unfortunately the recent fall in the price of sugar had left no margin for profits; they were in a much better position to make good cheap sugar than a year ago.

EDITORIAL NOTES.

THE severity of the past winter at this point may be seen by reference to the following table, showing the number of days in each month when the mercury reached zero, or below:

1884.	7 A. M.	2 P. M.	10 P. M.
Dec. 22	- 2	5	5
" 24	- 5	0	- 2
" 25	- 3	7	5
" 31	1	7	0
1885.			
Jan. 1	- 8	5	3
" 2		15	20
" 16	- 1	0	- 5
" 17	-10	5	6
" 18	- 1	5	2
" 19	- 3	4	3
" 20	- 3	16	10
" 21	- 3	- 2	- 6
" 22	- 8	13	20
Feb. 9	7	4	- 7
" 10	-16	- 7	- 1
" 16	-10	7	8
" 18	- 2	14	13
" 20	- 7	9	9

S. B. HILL, of Stockton, N. J., writes: "I am glad you continued to send the REVIEW for I think it the best periodical of the kind that I know of. I inclose $2.50 to pay for it another year."

MR. JOHN P. JONES, the archæologist, writes Feb. 10th, "Enclosed find $2.50 for the REVIEW. Glad you keep it going. I take most of the journals published in the United States of a kindred nature and do not find any that affords more satisfactory reading than yours.

DR. D. G. BRINTON, of Philadelphia, has in press the fifth volume of his series of "Aboriginal American Literature," entitled "The Lenâpé and their Legends." It will present the full original text and all the symbols or pictographs, 184 in number, of *Walum Olum*, or Red Score of the Delawares and has never been published before. Cloth, $3.00.

THE accomplished Librarian of Congress, A. R. Spofford, asks for back numbers of the REVIEW that he may have the volumes bound for preservation in that library.

THE State Normal School of Kansas, at Emporia, was founded in 1865. Its endowment fund is $182,331.40; annual income about $16,500. Total enrollment in 1878-9, 80. Total enrollment in 1883-4, 534. The total enrollment in 1884-5 will be much larger. It is strictly a Teachers' Training School, and offers excellent facilities for special preparation for the active duties of the profession.

PROF. C. F. CHANDLER, of the School of of Mines, Columbia College, New York City, editor of *The Photographic Bulletin*, which

commenced a new series with January, 1885, proposes to make it the organ for the interchange of ideas among scientific men and others interested in photography on the subject of photographing in natural colors. He desires correspondence on this subject, reports of phenomena that may have come under the observation of artists and others in this connection and suggestions as to the direction in which investigations should be pushed

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from* 15 *to* 20 *per cent off the retail price.*

WE find the *Atlantic Monthly* for March an unusually spirited number. Dr. Holmes definitely opens his "New Portfolio," which is exceedingly engaging. Beside the three serials by Mrs. Oliphant, Miss Jewett, and Mr. Craddock, there are several papers which are of value to thoughtful readers. The chief of these is a sketch by Clara Barnes Martin, called "The Mother of Turgeneff," which gives a strikingly vivid but not altogether pleasing picture of Russian home-life fifty years ago. Two scholarly articles, "Time in Shakespeare's Comedies," by Henry A. Clapp, and "The Consolidation of the Colonies," by Brooks Adams, an almost painfully realistic story by Bishop, called "The Brown-Stone Boy," and a delightful Mexican travel paper, with the grateful title of "A Plunge into Summer," by Sylvester Baxter, complete the longer articles of the number. The usual careful book reviews and short notices, together with the Contributors' Club close this attractive issue. Houghton, Mifflin & Co., Boston.

OUR former references to the high character of *Education* as an able educational magazine are fully sustained by its January-February number. Supt. Long, of St. Louis, discusses "Intellectual Training in Normal Schools," and Prest. Hunter, of the New York City Normal School, the "Necessity and Growth of Normal Schools." Prof. Anderson, of Aberdeen, Scotland, writes of "The Æsthetic Element in Education," and Mrs. Hopkins treats of "The Memory Faculty," in her course in Psychology. Prest. Bicknell's Annual Address before the National Educational Association at Madison, appears in full. Other articles are "The Lost Atlantis," by Mrs. Knight; "Quintilian's Educational Theory," and Foreign Notes. This number is embellished by a steel engraving of Louis Prang, the celebrated art publisher of Boston.

This magazine should be read by all thoughtful teachers and parents, as it embodies the best literature of the teaching profession. Price $4.00; single copies, 75 cents.

WHEN a new drama has proved successful, it is customary for the audience to call the author before the curtain. They have a curiosity to see what sort of man it is that created the play that has amused and instructed them. There is something very much like this in regard to our great newspapers; their editorial utterances are all anonymous, but there is generally a tradition of some half-shadowy personage who has established the journal, given it its character, and constantly directs it; and the public like to have him come before the curtain now and then, to address them in his own person. This Murat Halstead, of the Cincinnati *Commercial Gazette*, has done in the March number of the *North American Review*, to which he contributes an article on "The Revival of Sectionalism." In the same number, Archdeacon Farrar presents his views on "Future Retribution," and Prof. N. K. Davis discusses "The Moral Aspects of Vivisection" in a way that brings together briefly nearly everything that any person of note has said on the subject. Max Müller describes the astonishing ideas of the Buddhists on the subject of Charity, and George John Romanes opens up a great subject with an article on "Mind in Men and Animals." The other articles are one by President Gilman on Titles (chiefly scholastic), one by Judge John A. Jameson on "Speculation in Politics," and one by John W. Johnston on "Railway Land-Grants."